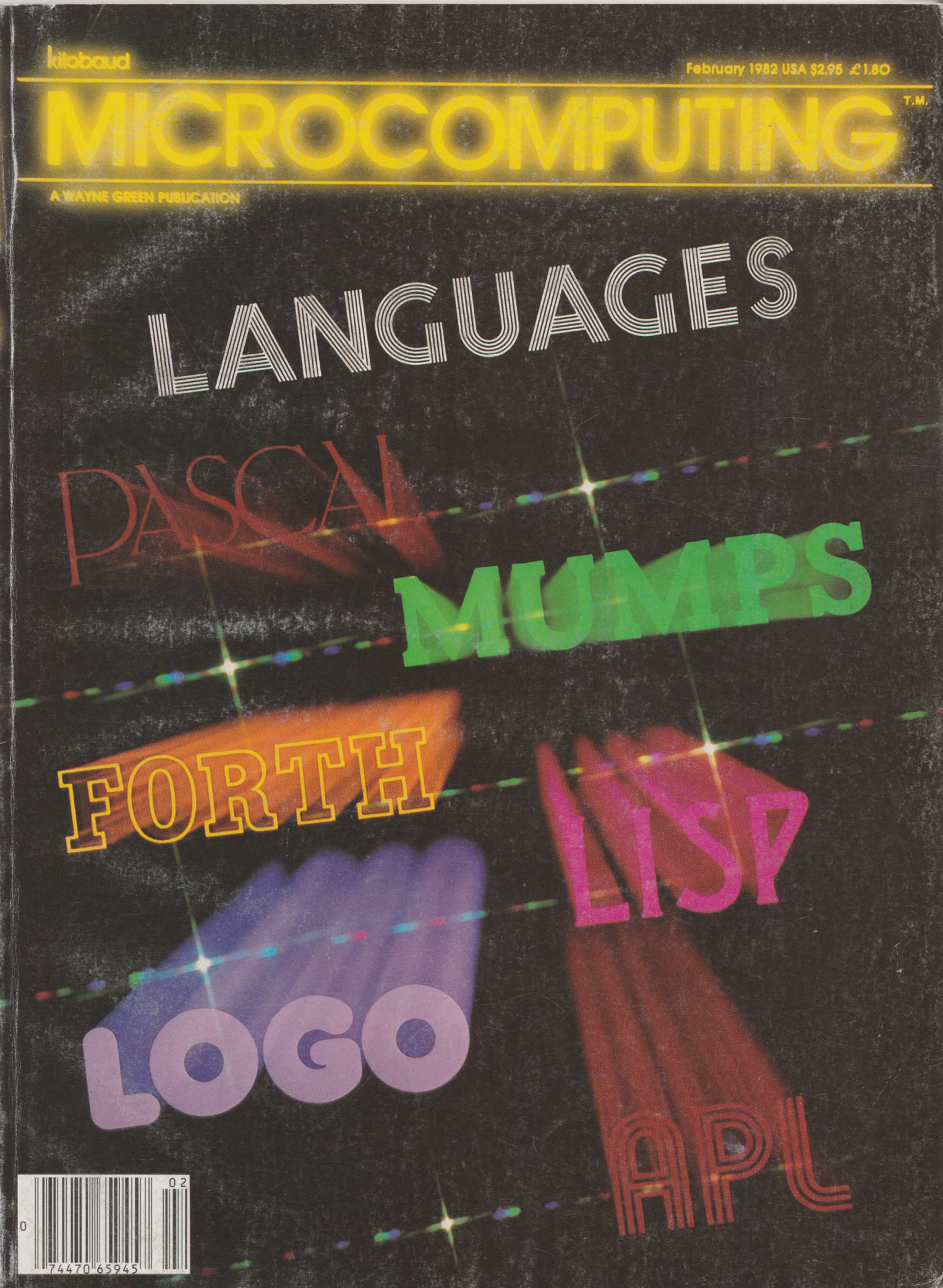
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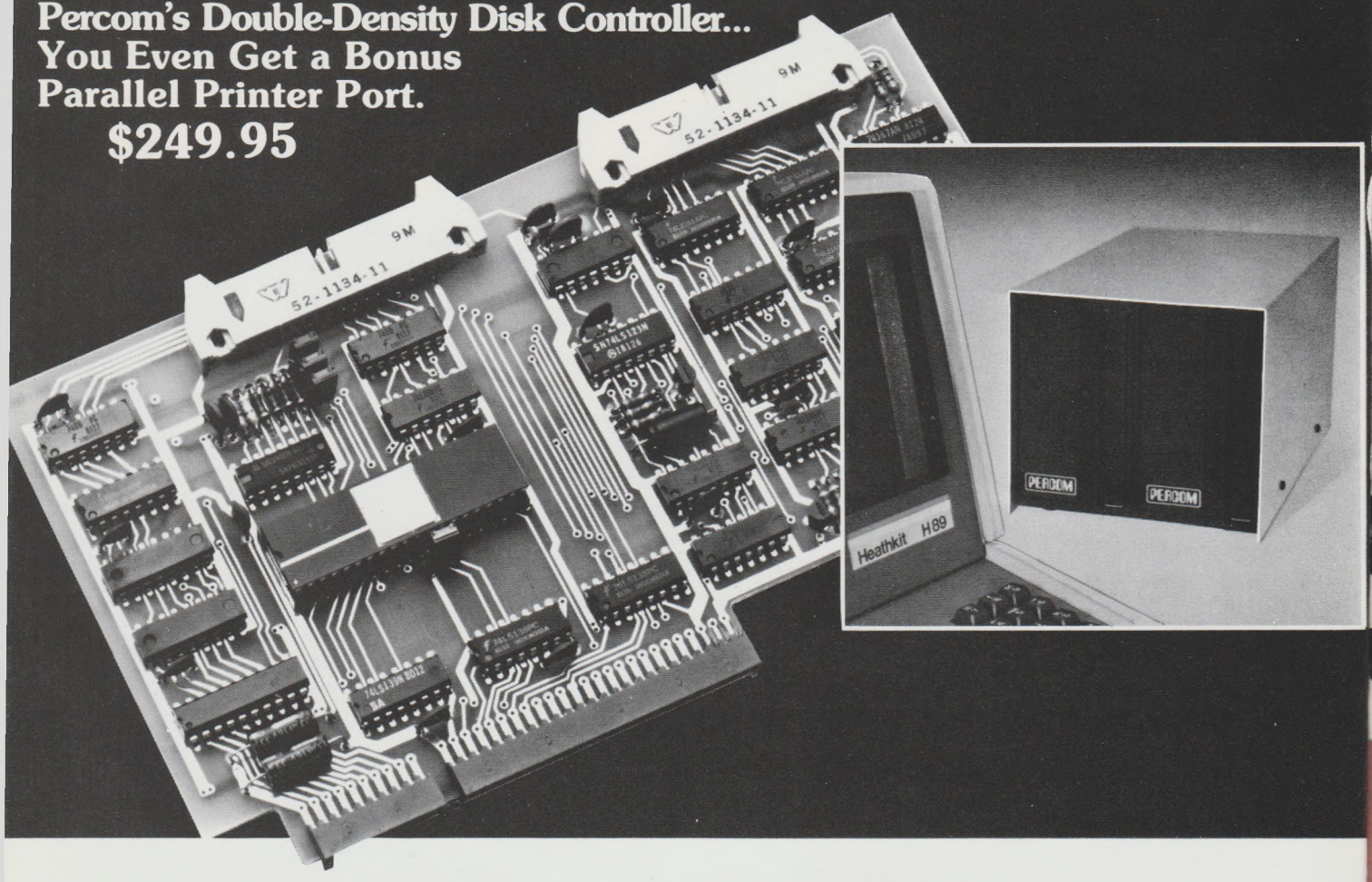
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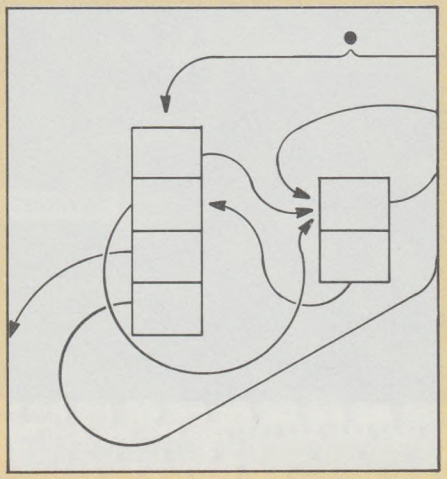
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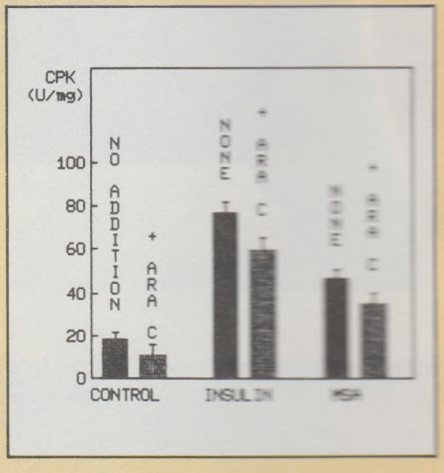
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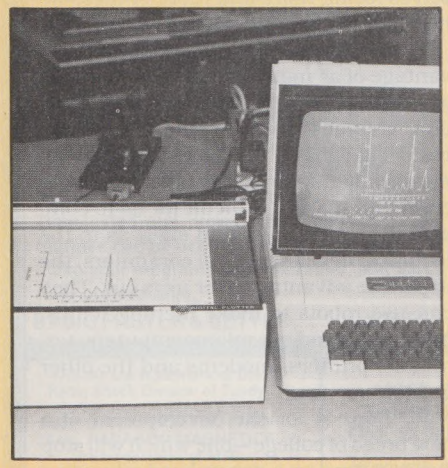
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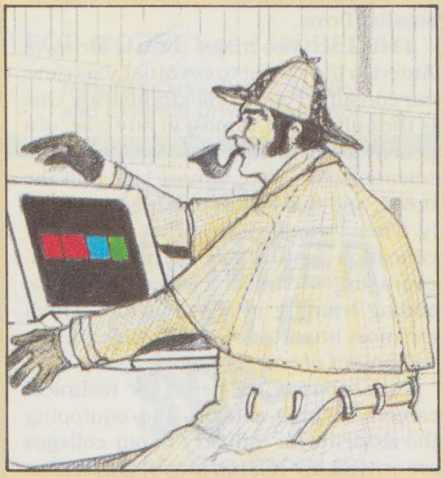
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By Wayne Green

Entrepreneurs Vital To Micro Industry



Viva Entrepreneurs

If you're into reading the business magazines, you know that the Japanese have developed some management techniques which are working heavily in their favor in fields where they are in competition with us. Their style of management results in substantially more productivity per worker as well as a much lower turnover of workers. Thus they get us two ways, and their goods cost less to make as a result.

It is costly when workers take coffee and smoking breaks. It costs when they make personal telephone calls. It costs when they chit-chat and gossip. It costs when they come in late and leave early. All of these little habits increase the cost of our products, making the bottom line higher than the Japanese. When someone changes to another company, a new person has to be hired and trained, and this adds to the cost of the products. When someone is sick or has to stay home to care for a sick family member, this adds to the cost.

One of the really heavy costs is when a union forces wages up for an industry year after year, finally putting the industry in a position where it can no longer be competitive with other countries (for example, the automotive industry).

More and more companies are finding that the Japanese management system is a winner. Oddly enough, the Japanese imported the idea from us a few years back and have been beating us with it. There are several books on the general subject of Theory Z management. Oh, I've heard the argument that Z management is in line with the Japanese tradition and not really something which can be used here. Well, you'll find that it is being imported very successfully, and that in many firms where the change has been made the turnover of people has dropped substantially and the quality of the products produced has shot upwards.

While there *are* some lessons we can learn from the Japanese—lessons which are being brought home by their success in more and more consumer-goods fields—not all of the lessons are telling us that the Japanese are doing everything better than we. We're still hanging in there with some strong plusses of our own.

One major plus is our entrepreneurial system. In Japan most of the business is done by huge firms, and their whole culture does not encourage the entrepreneur. Oh, they have a few, and many times they do very well. Most of their large firms were started by entrepreneurs. One of the factors which has helped these firms grow so huge has been the lack of competition by a host of other smaller firms.

Thus I see two major thrusts for us in America if we want to eventually retrieve our consumer electronics industries. One is the cultivation, almost at any cost, of a generation of technicians, engineers and scientists. We have almost killed off the breed, and this lack is hurting us severely. Then I would suggest that we aim our education institutions at not only encouraging technical careers, but also adding training in those factors which are most important to encourage the development of entrepreneurs.

Thus, sowing the seeds for technical careers in high schools and equipping the students for industry in our colleges are critical. By mixing practical business courses with technical training, the graduates will have the background they need to eventually start their own business. There will always be a good growth potential for new businesses because they are able to operate more efficiently than big business, and are able to come up with new products faster.

For example, look at the way a few hundred small businesses have run circles around Radio Shack in the support of the TRS-80 computer. Indeed, as fine as the TRS-80 is, without the support of these hundreds of firms, it would be just another microcomputer. Radio Shack has some good programs for their system, but they don't even hold a candle to many that are supplied by others.

Big business can never really crush small business because it moves too slowly, and by the time it has a competing product on the market the small company has an even newer and more innovative product. No, despite Japan's better technology—because they have us seriously outnumbered in engineers and technicians—I think our myriad of small businesses will be able to stay ahead.

Of course, if the computer industry were like the automotive industry, with only miniscule changes over the years, we would probably see the same pattern of fewer and fewer really huge businesses taking over everything. In the high-capital intensive parts of the industry, such as the making of large-scale integrated circuits, smaller firms are not able to compete. Indeed, we may see ourselves losing more and more of these inherently larger businesses to Japan.

The Japanese have rushed to take advantage of as many of the world markets as possible, thus increasing their production volumes and lowering their unit cost. They have introduced a growing number of industrial robots to further cut costs and make it difficult for us to compete. But with no end in sight as to the technical development of computers, the Japanese advantage over us is cut. They *can* use robots to make memory chips, but not to grind out microcomputers, terminals, printers, modems and the other gadgets we need.

My hope is for the development of a new breed of college—one which will stop wasting time on a generalized education and concentrate on the fundamentals of electronics, communications, computers

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When I stop in at Wendy's for one of the salad dinners—which I can eat and still count on losing a half pound for the day when I am dieting—I listen to the talking going on around me. It is no wonder that junior is unable to speak well, to read or to write. I hear few people who take any pride in their ability to speak, and I hear lazy speech.

Perhaps I was outstandingly fortunate to have parents and grandparents who took pride in the language. From my earliest years I remember arguments over the use of words, and looking them up in the dictionary to make sure that someone was right. This helped me develop not only a good vocabulary, but it also gave me an interest in the use of words.

It would be nice if families would work toward developing a pride in our language. My dream college will hammer hard at good speech—teaching students to use the language and to express themselves correctly. There will be few of the courses which wasted my college years—such as chemistry, physics, calculus, thermodynamics, strength of materials and so on.

An entrepreneur needs to know about personnel management, marketing, how to be a salesman, how to purchase materials, advertising, printing and things like that. He also should have a good grounding in the technical side of the field he is in. He may not want to be the chief scientist for the firm, but he does need to understand the technical end if he is going to make good business decisions.

Our colleges have not changed very much in the last hundred years or so. Perhaps it is time for a major change. The unrest of the 60s over irrelevant courses made a few changes, but nothing substantial. Now, with our private colleges going out of business all around the country, perhaps it is time to seriously consider a completely new format.

I believe that a college can be a real stepping-stone toward a career as an entrepreneur. Why do I stress this so much? Well, this is one of the few ways left in this world to make a lot of money. And without a lot of money it is difficult to be effective in making things happen. I've never had much personal use for money, but I've discovered that if my business efforts aren't profitable, I don't have the money to do other things. It takes money to make money, as I'm sure you've heard. Furthermore, as you make more money, people start to listen to you, which means you can be more effective.

So the first step is to get teenagers hooked on technical careers via ham and computer clubs in high schools. The next step is to develop some modern colleges where the kids we have infected with ham and computeritis can get the technical and business training they need. If you are involved with education, perhaps you can help with the changes that are needed.

Working at Home

Are you interested in having some fun and also making some money at home in your spare time? Well, gather round and fire up your computer; I have something for you.

You see, I have a problem and I need your help. Peterborough and the surrounding area is such a fabulous place to live that it is very difficult to move into the area. The town fathers have kept the growth down around 2 percent per year for the last 12 years or so . . . with no real expansion even in sight. It's a small town and it is going to stay that way.

Well, that's fine for Peterborough, but what about Instant Software, which is growing at an incredible rate? The fact is that even if we could find enough people to move to Peterborough, there isn't any room for them. So the obvious answer is to do as much of the work by mail order as we can . . . and that's what I'm writing about now.

There are a number of jobs at Instant Software which an energetic person could do at home. For instance, we need your help in sorting out the good programs from the crummy ones. We honestly don't want to publish anything but top-notch programs. We want to be sure that when people buy an Instant Software program they are getting a super program at a bargain price. Well, we can sort through the obvious dogs in our lab, but when it comes to shooting holes in the more complex programs, we just don't have the people or the time.

Another remote job can be writing documentation. Of course, we do try to get our authors to put as much of the instructions needed right into the program, making them self-documenting. But with many systems stopping at 48K there are programs which just can't have everything built in. For this we need people with a computer and an interest in writing. The idea is to make the instructions fool-proof.

Another chore that is more than we can handle in-house is converting programs from one system to another. Oh, we tackle some of the urgent ones, but it takes several days for each and we just don't have enough staff. If you're interested in doing conversions, please let me know. Most of the programs come in for the TRS-80, so you'll need one of those . . . and we're looking for programs for almost any other system, so what else have you?

Speaking of systems, once you start doing serious work at home, I don't think you'll have any problem charging all of the hardware and most of the other computer expenses up to business. After all, you'll be making money at it, so it's a business. Being able to tax-deduct all of your computer gear won't hurt.

Another little chore, for those of you who have a native language other than English, is translating our programs into other languages. We need translations into German, French, Italian, Spanish, Swedish, Dutch, Japanese, Korean, Greek, Hebrew . . . and what else is there? No language students, please—just people with a solid understanding of the languages. We have a couple of hundred programs which need translation—so get in touch and get started.

How much does all this pay? Well, it doesn't pay a fortune, but it's a nice little plus for the home hacker. Why not make money while you are learning more about your system? And, once you get good at programming you can write programs and retire on the royalties. Right?

The other day I worked up a diagram of the process we go through to accept and publish a submitted program. It's quite a chart, with about 225 separate steps involved in the process and a cost today of about $4000 to get a program through the mill and into the stores. You can understand why we need to be sure that the program is a good one.

The Instant Software in-house staff numbers about 50 people, with at least that many supporting the effort in other departments on a part-time basis. They evaluate the programs, write the documentation, make the masters of disks and tapes for duplication, design the packages, and so on. It's a big deal.

Some of the staff write and produce the catalog; send out information on new packages to our reps around the country, to the computer stores and other retailers; handle orders; and work in the shipping and accounting departments.

At any rate, if you're interested in working with us to evaluate programs, write documentation, convert them for other systems or do translations, please drop me a line and I'll send you the details. □

MICRO QUIZ

Analysis of Algorithms

What is the maximum number of times that line 150 could be executed in the following program?

```
110  DIM A(5)
120  FOR I = 1 TO 4
130     FOR J = (I + 1) TO 5
140        IF A(I) = A(J) THEN 160
150           T = A(I): A(I) = A(J): A(J) = T
160     NEXT J
170  NEXT I
```

(answer on page 190)

Reader Service for facing page ~ 188

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By Robert W. Baker

A "Friendly" New Language

RPL Is Fast, Easy to Use, Efficient

Here's a new language, developed by Timothy Stryker of Samurai Software, exclusively for the Commodore series of computers. It's called Reverse Polish Language (RPL), and is patterned after the popular Forth language, which also uses reverse Polish notation.

RPL has a number of advantages over Forth. It uses memory more efficiently, and is much friendlier. The RPL documentation even includes a short comparison between Forth and RPL.

The term "reverse Polish notation" refers to a method of specifying the order in which mathematical operations are to be performed, pioneered by the Polish mathematician Jan Lukasiewicz earlier this century. If you ever used a Hewlett-Packard calculator, you've seen it work.

Suppose you want to print out the result of adding 5 to 3. In BASIC, you would simply type PRINT 5 + 3. Things are a little more complicated in RPL, but with good reason.

RPL has something called a parameter stack, which is really a last-in-first-out stack of information. The last item written in the stack is the first item read back out. If you want to perform some operation on two numbers, you first put the two numbers on the stack, one after the other, and then call the desired operation. The called operation removes the correct number of parameters from the stack, performs the operation, and then pushes the result back on the stack. Thus, in RPL, to add 5 and 3 you would specify that you want to push a 5, then push a 3, then add the last two numbers on the stack. When executed, this little three-step program, 5,3,+, will leave the result (8) sitting on top of the stack.

How do you get the result from the stack to the display? Well, first you have to convert the result into printable form, and then you have to actually ask for the result of that conversion to be printed. So you say STR$, which pops the number from the top of the stack and then pushes an equivalent character string back onto the stack. Now all you have to do is say PRINT, which invokes a little program that expects to find a character string on the stack. This command now simply pops the string off the stack as it is printed.

Thus, the RPL equivalent of BASIC's PRINT 5 + 3 is 5,3,+,STR$,PRINT. You can read the RPL line as "push a 5, push a 3, add them together, convert the result to ASCII and print it out."

To turn this into a real live RPL program, you'd also have to place a line number at the start of the line. Thus, the entire program line looks like:

```
10    5,3,+,STR$,PRINT
```

Just a side note here for those more learned PET/CBM followers. Normally this line would be entered as line number 105, since the space between the 10 and the 5 would be ignored. However, when the RPL module is loaded there is code that eliminates this type of problem. Getting back to RPL, Table 1 shows a list of the available RPL operators and a brief description of what each one does. The RPL documentation is excellent and includes detailed descriptions of each operator along with examples.

On the RPL parameter stack, each piece of numeric data is normally stored as a two-byte, binary value with the uppermost bit indicating the sign. This limits numbers to the usual integer range of −32768 to +32767. However, this range can be viewed as extending from 0 to +65535 if you're using a full 16-bit unsigned binary value and are careful when performing your arithmetic operations.

Character strings, on the other hand, can contain any number of characters. Any given string is pushed onto the stack in reverse order such that the first character popped is the first character in the string. Additionally, the string length is pushed onto the stack after the actual string. Thus, the string length is popped from the stack before the string itself, so the routines know the length of the string they are working with.

Once a character string has been pushed onto the stack, or has been created on the stack by some operator (like STR$), it need not be immediately printed out. You can manipulate the pieces of the string using other ordinary stack operators, just as you would any sequence of stack entries. In this way you can mimic the BASIC operations of LEFT$, RIGHT$, MID$, string concatenation, etc. Conversely, there is nothing to prevent you from building you own strings from scratch. The PRINT operation simply uses the first value from the stack as the string length and the next n-characters as the string.

As I said earlier, everything you do in RPL gets done with entries on the parameter stack. Generally, entries are either an integer number or an ASCII string preceded by its length. How much simpler could it be? Now let's take a quick look at what you can do with the stack entries once you get them on the stack.

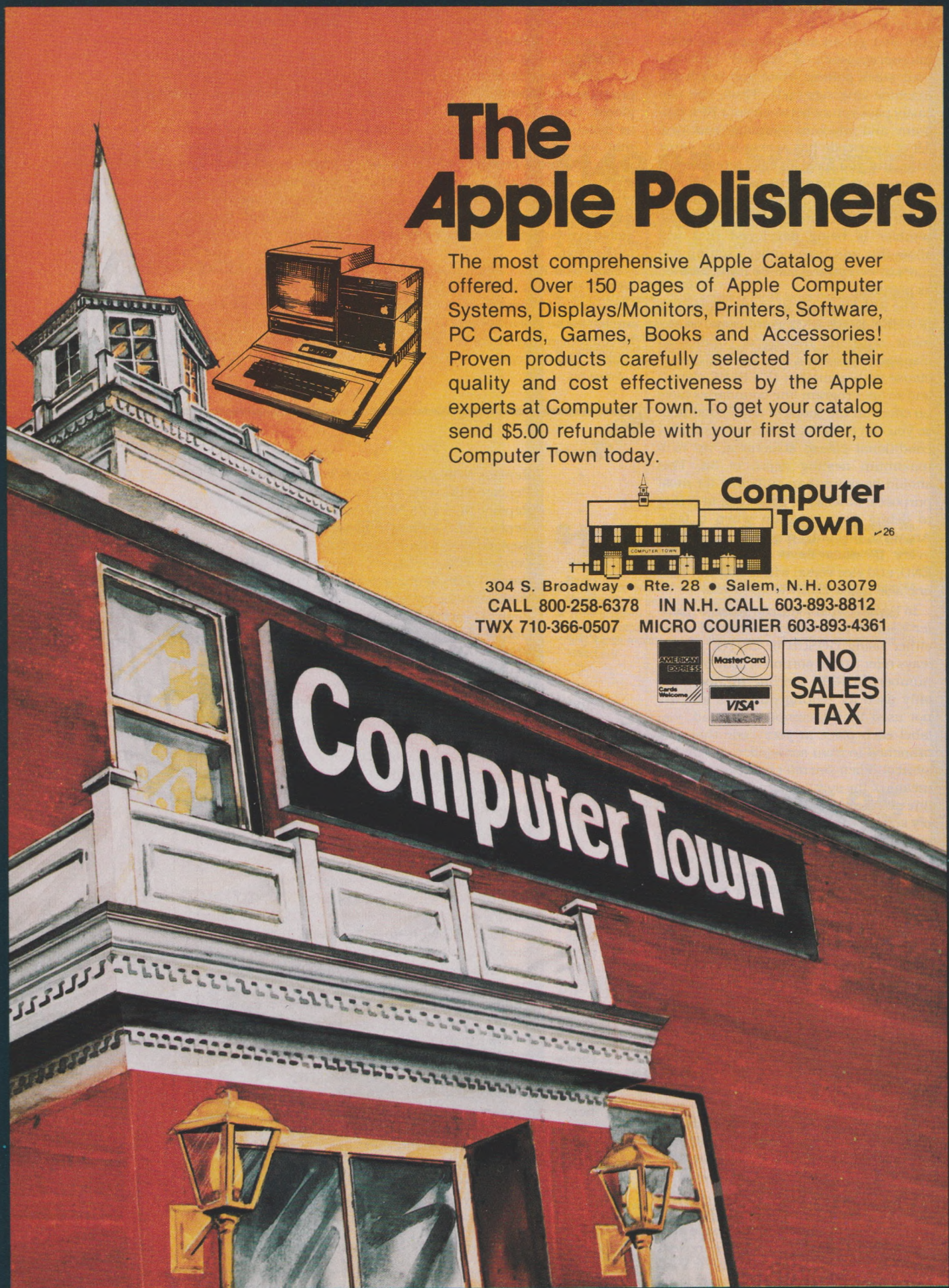
Looking at the RPL operators shown in Table 1, notice the usual arithmetic, logical and string input/output operators. Other operators are provided for creating random numbers and FOR-NEXT loop controls. Also, a number of stack manipulating operators let you do just about anything you can imagine with the stack.

Other operators that deserve special mention include two versions of the usual PEEK and POKE commands to support both one- and two-byte operations. These operators give direct access for reading and writing any memory location. The INT operator even lets you interchange the high- and low-order bytes of a two-byte value for creating 6502 addresses in the correct format.

With the SYS operator, you can ac-

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cess machine-language routines the same way as in BASIC. However, with RPL you get an added bonus: the 6502 microprocessor's X register becomes your stack pointer when you reach the machine-language code. Thus, you can easily pass values between your RPL program and machine-language routines. All of your code has access to the same data, and you have an easy interface between them. There's even a way to generate machine-language routines directly within an RPL program. A special assembler is being developed that will allow this and many other exciting features, if everything can be implemented as planned.

The RPL language supports a complete IF-THEN-ELSE-END conditional statement, with full nesting of conditional clauses. This means you can have one IF-clause within another IF's ELSE clause, and so on. Program line boundaries have no effect on the scope of an IF condition, so you can construct arbitrarily complex conditional clause structures, up to a maximum nesting depth of 38. This should be more than sufficient for most purposes; otherwise, good luck in trying to debug your program when it fails. Anyway, the only requirement is that every IF must have a corresponding END, and vice versa; whether or not each one also has a THEN is up to you.

In BASIC, whenever you want to transfer control to another portion of code, either using GOSUB or GOTO, you always refer to that portion of code by a line number. In RPL, the line numbers are only used for editing purposes and are not used by the compiler. Instead, you label each place in your code that gets branched to from someplace else with a symbol. Then you refer to those places by means of the symbol name instead of the line number. You define a symbol by simply stating the symbol name, following it with a colon. The symbol name must be composed entirely of alphabetic characters or back-arrows, but can be of any length. Lengths in excess of 50 characters should be avoided, since they may overflow the compiler's stack.

The other use of symbols for which a parallel exists in BASIC is that involving variables. For simple applications in RPL that only require a small amount of data, the data can normally be stored and manipulated on the parameter stack without using variables. It is generally only necessary to store data off the stack when you start getting into more complex applications.

Unlike BASIC, RPL does not automatically allocate space for variables for you; you must do it yourself. In fact, the RPL compiler doesn't even know what a variable is, in the sense used by BASIC. Instead, RPL lets you allocate memory space and apply labels to the space allocated. The compiler couldn't care less what you use the space for, be it variables, machine-language routines or something else.

To make a global symbol, all you do is define it using a double-colon instead of a single one. Once you've compiled a program containing symbols defined as global, those symbols may be referred to from an entirely different program that you compile later. To make this work, you must be sure that (a) the object code of any routine you define globally does not get clobbered before it is used and (b) you preserve the contents of the global symbol table from one compilation to the next.

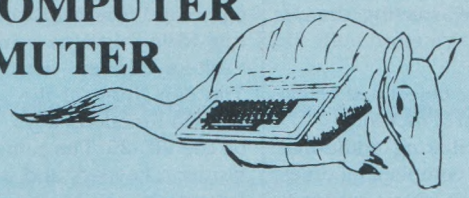
Since the RPL Compiler is written in RPL, it compiles itself. As a result of this compilation, a number of global symbols are left in the global symbol table and can be referenced anywhere in your own programs. The text of each routine is shown in the documentation, along with appropriate comments on their use.

Before going on, I should mention two very important points about RPL. First, you have to distinguish between things that happen at compile time, and things that happen at run time. The compiler is the entity that looks at your source program and generates the executable program, allocates memory and presets initial conditions. When you first run a program after it has been compiled, the allocated memory locations contain the predefined values set during the compile. If you run the program a second time without compiling the program again, nothing has come in to get the contents of your so-called variables back to zero, or to whatever other initial value was specified. So, unlike BASIC, which zeroes out your variables for you

Operator	Description
+	Replace NOS with NOS plus TOS, pop TOS
–	Replace NOS with NOS minus TOS, pop TOS
*	Replace NOS with NOS times TOS, pop TOS
/	Replace NOS with NOS divided by TOS, pop TOS
\	Replace NOS with NOS modulo TOS, pop TOS
str$	Convert TOS to character string in base-10
chr$	Convert TOS to character string in hexadecimal
0—9	Push numeric constant as defined
"..."	Push character string as defined within quotes
print	Output character string on TOS to display
>	Replace NOS with logical NOS>TOS, pop TOS
<	Replace NOS with logical NOS<TOS, pop TOS
=	Replace NOS with logical NOS = TOS, pop TOS
and	Replace NOS with NOS logical-AND TOS, pop TOS
or	Replace NOS with NOS logical-OR TOS, pop TOS
not	Replace TOS with 1's complement of TOS
#	Push another copy of TOS
;	Push another copy of NOS
↑	Replace TOS with the TOS-th deep stack entry
%	Swap NOS with TOS
$	Rotate TOS-th stack entry out to TOS
.	Pop TOS
new	Pop everything on parameter stack
int	Interchange high and low-order bytes in TOS
@	Replace TOS with 2-bytes pointed to by TOS
!	Store 2-byte NOS at address on TOS & pop values
peek	Replace TOS with single byte that TOS points to
poke	Store single byte NOS at address on TOS, pop TOS and NOS values
&	Call RPL routine at address in TOS, pop TOS
return	Return to subroutine caller
sys	Call machine-language routine at address on TOS, pop TOS
goto	Go to address on TOS, pop TOS
if	If TOS = 0, go to corresponding "then" or "end," pop TOS
then	Begin definition of else-clause for corresponding "if"
end	Define end of if-clause or else-clause
for	Start for-next loop, from TOS to NOS, pop values
next	End for-next loop
fn	Push current for/next counter value
clr	Clear out current for/next loop context
rnd	Push a random 2-byte quantity
get	Push byte from keyboard, or 0 if none available
input	Await keyboard input, push character string
stop	Halt RPL execution, return to BASIC

Table 1. RPL operators. (TOS means top of stack; NOS means next on disk.)

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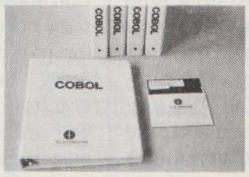
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- **PERFORM...THRU...TIMES...UNTIL**...paragraph or section names.
- **IF...NEXT SENTENCE...ELSE...NEXT SENTENCE AND/OR <=> NOT.**
- **GO TO...DEPENDING ON...**
- Interactive **ACCEPT/DISPLAY...**
- **RELATIVE** (random) access files
- Sequential files both fixed and variable length.
- **INSPECT...TALLYING...REPLACING.**

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each time you say RUN, RPL does only what you specifically tell it to do when storing values into labeled locations. If you've ever programmed in assembly language, this should look familiar.

Second, you pay a price for being able to treat program symbols and data symbols completely interchangeably. If you make a mistake in your program and try to branch to the wrong symbol, RPL will blindly follow along and begin doing all sorts of things that you had no intention of doing. Again, this is a familiar problem for assembly-language programmers, not just in RPL.

Any reasonable computer language has to allow its user to place comments and notations within the program for documentation. In RPL this is done by first writing one program line containing nothing but the word REM, then writing your comment in the following line or lines, followed by another line also containing nothing but the word REM. Comments of this type can be placed between any arbitrary pair of lines, anywhere in a program. Comments do not take up any memory space in the object code and execution passes through them as though they weren't there.

You may find a few features regarding comments to be handy. First, you can put a block comment at the beginning of your RPL program without using a leading REM line, since the compiler actually compiles your program from bottom to top. What you think of as the beginning of your program is the last thing the compiler looks at, so it makes no difference if the compiler is reading comments when it reaches the top.

Also, you can actually place a BASIC program within an RPL program as a block comment. With a little fancy programming, you can have two programs in one. By giving a RUN command you can execute the BASIC portion. By giving the RPL compile command you can compile the RPL portion. Once the RPL version is compiled you can then execute the RPL version or the BASIC version.

As I hinted earlier, there is an easy way to allocate and label memory space for whatever use desired. All you do is place any arbitrary list of numbers or symbol names within brackets. The compiler will then generate a list for you in memory in simple numeric form, with two bytes per entry. The compiler will even resolve the symbols that appear, if there are any. This lets you in effect create predefined arrays of various kinds with very little effort. This can even be used to create RPL equivalents of the BASIC ON. . . GOTO and ON. . . GOSUB commands.

Ordinarily, you do not want to get involved in determining where in memory your object code is to go. On the other hand, you do need a certain amount of flexibility for: linking modules together using global symbols without overwriting one another; for creating a final, saleable product module that doesn't contain the compiler itself; or for compiling a program too big to keep both the source and the object in memory at one time. A number of options are offered by the compiler in response to several prompts before starting the actual compile:

- DEFAULT places the object just below the compiler at the top of memory
- CONTINUE allows linking additional modules to previously compiled modules
- REPEAT rebuilds the object where it started building it during the previous compilation
- SOURCE builds the object right on top of your source
- COMP builds the object right on top of the compiler
- FINAL builds the object right up flush against the bottom of the RPL "run-time-library," and represents truly the limit in terms of memory space efficiency. This option is normally the one used to create a saleable object product without including the compiler itself
- DECIMAL# allows you to directly specify where to place the object

Other compile time options let you control the use of the global symbol table in various ways.

A list of all of the types of errors that the compiler detects, along with an explanation of each, is presented in an appendix within the RPL manual. These are all errors that are detectable at compile time only. It is generally not advisable to try to execute any RPL program following one of these error messages.

Run-time error-checking has been almost completely eliminated from the RPL package to provide higher execution speed and lower memory usage. The only checks made during execution are for parameter stack overflow or underflow. The stack will overflow whenever you try to put more than 63 items on it. It will underflow if you try to pop or otherwise make use of a stack item that's not there. Both of these conditions halt execution immediately and present a stack error message.

In any BASIC programming you've done up to now, BASIC has always let you know when and where you've done something wrong. The price you paid for letting BASIC hold your hand was that many of your programs would only execute at a very small fraction of the speed they could have if you were to make full use of the power of the 6502 microprocessor inside the Commodore system.

RPL does not, by any means, claim to offer some fantastic increase in program operating speed. Instead, it occupies a very useful midrange in the trade-off between ease of use and speed efficiency, while offering a considerable memory space savings in the bargain. On the other hand, you can make many errors that RPL will not catch, and your program may go quietly insane for no apparent reason.

Fortunately, a very sophisticated symbolic debugger called SIM is also available for RPL program development. This package is initiated by a SIMULATE command from BASIC, and lets you debug RPL programs using an interactive "soft-key driven" execution simulator. You can think of the soft keys as predefined functions keys, much like those on the VIC-20. The actual keys are in the numeric keypad, and a small matrix of legends is constantly displayed in the lower right corner of the screen showing their currently defined functions.

The debugger can single-step through your RPL program at any point. The operator or operation to be executed on the next step is displayed as it appears in the source code for almost every operation. At the same time, the complete contents of both the parameter stack and the return stack (up to 18 entries deep) are constantly displayed.

A host of extra run-time error-checking functions are also included to look for things like NEXT without FOR, RETURN without &, return stack overflow, execution of illegal RPL operations, etc. You can even set breakpoints or examine and modify memory locations. Addresses can be expressions which may contain references to symbols from both the global symbol table and the most-recently created local symbol table.

The debugger is completely transparent to the RPL program. It does not use any additional zero page or tape buffer memory locations. Best of all, it does not interfere at all with the simulated program's use of the video display. A screen-memory swapping scheme can restore the true display at any time desired and then return to the debug environment.

Conclusion

In summary, RPL offers an unbeatable combination of speed, memory space efficiency and ease of use. It gives someone with little or no assembly-language programming experience the ability to generate high-speed programs without getting into the nitty-gritty aspects of assembly programming. If you know machine language all ready, you may find RPL much faster to implement without sacrificing too much execution time.

Depending on your particular background, you may find the idea of using stacks easy or hard to understand. However, most people can pick this concept up pretty quickly. At any rate, it should be much easier to understand than assembly-language programming.

The entire RPL package is well designed, well implemented, and well documented. It certainly deserves serious consideration by anyone interested in more efficient programming.

At this writing, the RPL Compiler is

$49.95 on disk, $44.95 on cassette. The debugger is $39.95 on disk and $34.95 on cassette. For an 8K machine, the debugger is $24.95 on disk and $19.95 on tape. If you order the debugger with the compiler you can deduct 10 percent from these prices. Manuals are $10 for the compiler and $4 for the debugger. Cost of the manuals can be applied toward the package prices. Source code may be available but pricing has yet to be determined. All current ROM versions and program media are supported. For latest pricing and additional information you can write: Samurai Software, PO Box 2902, Pompano Beach, FL 33062. Watch this and other magazines for possible application programs written in RPL.□

```
100 ************************************
110 *                                  *
120 * SAMPLE RPL PROGRAM               *
130 * THAT PRINTS THE MULTIPLICATION   *
140 * TABLES FOR PRODUCTS UP TO 9*9    *
150 *                                  *
170 ************************************
180 REM
200 "***" PRINT 9,1 FOR FN CVTDEC & PRINT NEXT 13,1 PRINT
210 "***" PRINT 36,1 FOR "." PRINT NEXT 13,1 PRINT
220 9,1 FOR FN CVTDEC & . . . 2 PRINT ":" PRINT
230 FN 9,1 FOR # FN * CVTDEC & PRINT NEXT . 13,1 PRINT
240 NEXT STOP
250 REM
260 THIS ROUTINE CONVERTS THE NUMBER ON THE STACK INTO
270 A DECIMAL STRING AND THEN PADS IT ON THE LEFT WITH
280 BLANKS SO AS TO MAKE A STRING EXACTLY FOUR
290 CHARACTERS LONG.
300 REM
400 CVTDEC: STR$ 4 % - 1 FOR 32 NEXT 4 RETURN
READY.
```

Sample program.

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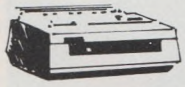
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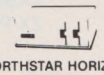
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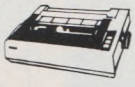
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D-Cat	199	150
Auto-Cat	249	190
Apple-Cat	389	310
DC Hayes Micro-100	379	330
DC Hayes Smart Modem	279	240



EPSON PRINTERS

	List	Sell
MX-80	645	CALL
MX-80 FT	745	CALL
MX-100	995	CALL

Call for pricing on interfaces and cables



MORROW DECISION COMPUTER

	List	Sell
Decision 1 BASIC	1725	1350
Decision 2	CALL	CALL
65 K Static Ram	1000	780
Switchboard I/O	259	210

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MORROW DISC SYSTEMS

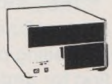
	List	Sell
Discus 2D 1 Drive	1095	849
Discus 2D 2 Drive	1875	1389
Discus 2 + 2 1 Drive	1395	1075
Discus 2 + 2 2 Drive	2495	1859
M26 Hard Disc	4495	3395

CP/M & Microsoft Basic included



LINE PRINTERS

	List	Sell
Okidata 82A	719	550
Okidata 83A	1195	899
Anadex 9500	1650	1285
Anadex 9501	1650	1285



SYSTEMS GROUP

	List	Sell
2800 Computer	5035	3595
DM-6400 Memory	760	585
DMB-6400 Memory	995	735
CPC-2813 CPU + I/O	460	365
FDC-2801 Controller	465	370



MICROPRO SOFTWARE

	List	Sell
Wordstar	495	330
Apple Wordstar	375	275
Spellstar	250	190
Mailmerge	150	100
Datastar	350	250
Supersort	250	190



DISC-CABLES

	List	Sell
Memorex 5" 1D	47	27
Memorex 5" 2D	55	36
Memorex 8" 1D	65	40
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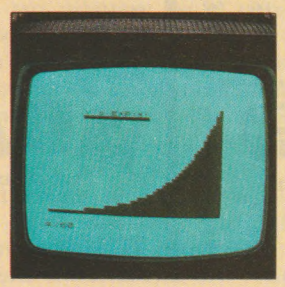
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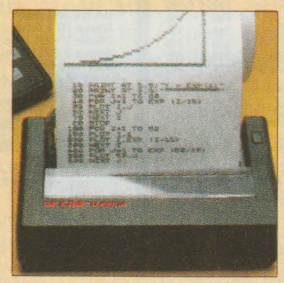
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By Frank J. Derfler, Jr.

Dits and Dahs Of Computing

Hams Break New Ground (Again)

Welcome to Dial-Up Directory! Every month in this column I bring you the latest news and views on how to use your microcomputer as a data communications terminal. This month, I'm going to look at how amateur radio operators are bringing together radios and computers to make systems that are breaking new ground in data communications. I'll also pay a photographic visit to the Hayes Microcomputer Corporation in Atlanta, GA. But first, a few random bits from the mailbag.

Closer and Closer

The Source information utility has made a major change in format. They have provided an optional menu to help users take full advantage of their services. You can still use all of the old commands in the direct command mode, but the optional menu will help guide you to new services or show you some of the features available on the system without printing out a complete index. The initial reaction to the optional menu format has been very positive.

It's interesting to see how the two competing information utilities, CompuServe and The Source, are solving the problems involved in this new business. They have taken two different approaches, yet the solutions look a lot alike. The differences between the services now resemble those between a Ford and a Chevrolet: price, specific features, availability and an unmeasurable characteristic called style.

Speaking of features, CompuServe has announced that it is working with World Book Encyclopedia to develop an on-line, electronic version of the encyclopedia. Your friends who ask you, "But what do you *do* with a computer?" may not understand an "information utility," but every American is conditioned to believe that encyclopedias are good things to have in homes.

A home with school-age children is not considered complete unless it has an encyclopedia set, even though most people also know that these expensive books go out of date amazingly fast. A constantly updated electronic encyclopedia is something most people can understand. I don't know how effective the electronic World Book will be in transferring information, but I predict it will be a big psychological factor in increasing the popularity of information utilities and microcomputers.

Oh yes—the folks at The Source have also been talking with a major encyclopedia publisher for some time—the more things change, the more they stay the same.

System Listings

This column used to provide a listing of available electronic message systems. However, publication lead times and the transient nature of many of these systems combined to make our listings out of date before they arrived in your mailbox. If you like this service, you will be interested in the On-Line Computer Telephone Directory published by Jim Cambron. Jim is putting out a quarterly listing of electronic message systems and he puts a lot of effort into ensuring that it is as accurate as possible. The subscription rate is $9.95 per year. Contact Jim at PO Box 10005, Kansas City, MO 64111, or on CompuServe through 70040,414.

Dits and Bits

Amateur radio operators have been using a form of digital communications since the early 1900s. The dits and dahs of International Morse Code signaling make up just as valid a digital alphabet as the zeros and ones of ASCII. Continuous wave (CW) code transmissions are still popular with radio amateurs because they can carry the message when more sophisticated voice systems are blocked by noise or other conditions.

After World War II, hams began using Murray/Baudot code in radioteletype (RTTY) communications. Speeds of 60 to 100 wpm are still commonly used. But radio amateurs have not stopped with the simple hand keys used to send Morse code, or with mechancial teleprinters. Their interest in technology and electronics placed hams among the first to be involved with microcomputers and microprocessors (a guy named Green, call sign W2NSD, was there early). A number of programs have been published which use the keyboard of a micro-



That's Glenn Sirkis, vice president of Hayes Microcomputer Products, coming out the door of their executive offices to meet us. Hayes employs about 80 people full time.

computer to generate CW and RTTY signals used to key a radio transmitter. Other programs even display the decoded radio signals on the computer's screen.

A company that has been supplying ham radio peripherals for years has recently introduced a hardware/software package that provides the TRS-80 Model I or III with a complete CW transmission and reception capability. The MFJ 1210 (Model I) or 1212 (Model III) lets the user send CW from the keyboard and receive CW on the display screen.

It features a tri-split screen for received messages, transmit buffer and programmable message index. You can preload the text buffer while receiving and then transmit when ready. There are ten 199-character programmable message memories (macro files). You can combine these messages together as needed.

On receive, there is an adjustable "fist fixer" with an on-screen analog indicator. This alters the computer decision-making process and improves copy of poorly sent CW. The hardware interface plugs between the transceiver and the computer. No modification is needed to the ham rig or computer.

The complete package with all needed hardware and software is available for about $100 from MFJ Enterprises, Inc., PO Box 494, Mississippi State, MS 39762.

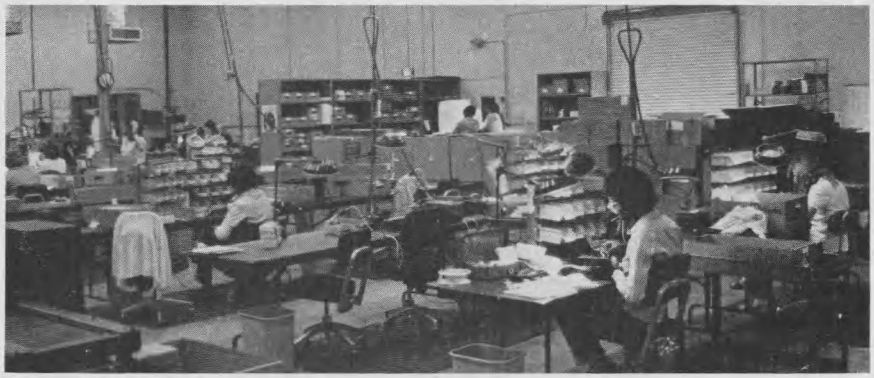
The amateur who prefers to homebrew his own equipment (or anyone interested in Murray communications with the TRS-80) would find volume 4 of the *Disassembled Handbook for the TRS-80* very interesting. This publication is a spiral-bound notebook of over 200 pages. It is packed with programs and operating hints on how to use the TRS-80 Model I/III in CW, RTTY and ASCII communications. The book is written in an enjoyable and readable style and I personally recommend it. It is also available in French and German. Volume 4 of the *Disassembled Handbook for the TRS-80* is available from Richcraft Engineering Ltd., Drawer 1065, Chautauqua, NY 14722, for under $20.

Amateur radio operators are now using microprocessors to push the state of the art in digital communictions. Amateurs in Canada and the U.S. are using a radio transmission system that is still in the preliminary development stage in government and commercial R&D laboratories.

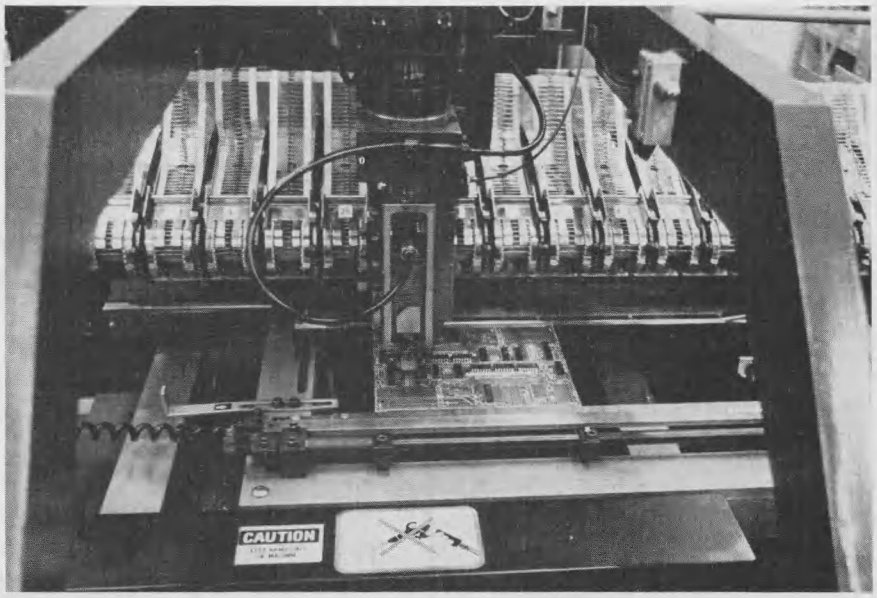
Packet radio communications systems are being developed by the Defense Advanced Research Projects Agency and possibly a few other commercial interests. Amateur radio operators have had operational packet repeaters in Canada since 1979. The introduction of systems into the U.S. was delayed by lack of permission from the FCC to transmit ASCII.

Packet radio doesn't imply a transceiver that you put on your back and carry around. It involves the transmission and reception of the same kind of packets of digital information used by carriers such as GTE Telenet and Tymnet. When you use one of these carriers to contact an information utility like The Source or CompuServe, the carrier chops the stream of digital information you send out into standardized packets of information.

The size of these packets varies with the system you are on, but each packet will have some information identifying its name, sequence, address and error check along with a piece of the data you sent. The concept is that packets from many users can be intermixed to make



This is the Hayes assembly area. All Hayes modems are made in this facility. Parts flow in from the right, and completed modems flow out to the left.



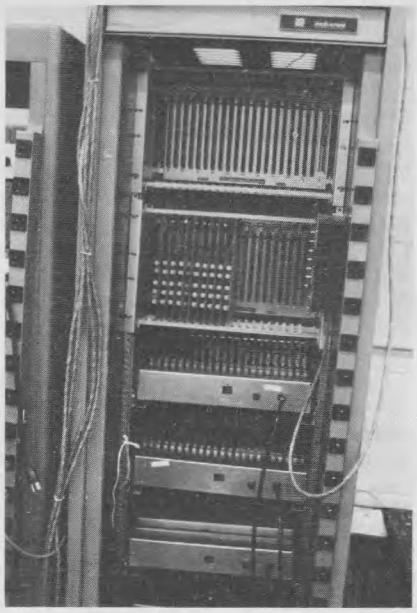
This machine, driven by a microcomputer, stuffs the most common resistors, capacitors and other small parts into two modem boards at a t me.



The quality control section at Hayes is an important part of the manufacturing process. Each component and solder joint is visually inspected.



After wave soldering, hand soldering and inspections, each modem board is tested by a series of locally developed programs. These programs thoroughly exercise every function of the devices.



Both S-100 bus and Apple II modems are being burned in in this cabinet. This testing and quality assurance allows Hayes to provide a two-year warranty on their products. So far, they have never charged for the repair of a modem.

the most practical use of the data communications channel. Packets are sorted, routed and sent on their way independently. At the receiving end they are captured, lined up in order and strung together again.

Various nodes along the way examine and regenerate packets. Packets can have multiple or single addresses. All of these transmission and reception functions can be done very well over wire circuits, but when you start trying to use these sophisticated techniques in narrow radio channels, some real creativity is needed to keep things simple.

The concept used in some amateur radio packet systems is to have a local area repeater station retransmit the packets addressed to it. Many stations can operate on the same frequency, and they can all exchange packets through the repeater at the same time. The short packet length and various kinds of collision detection schemes allow what appears to be simultaneous use of the frequency by many stations.

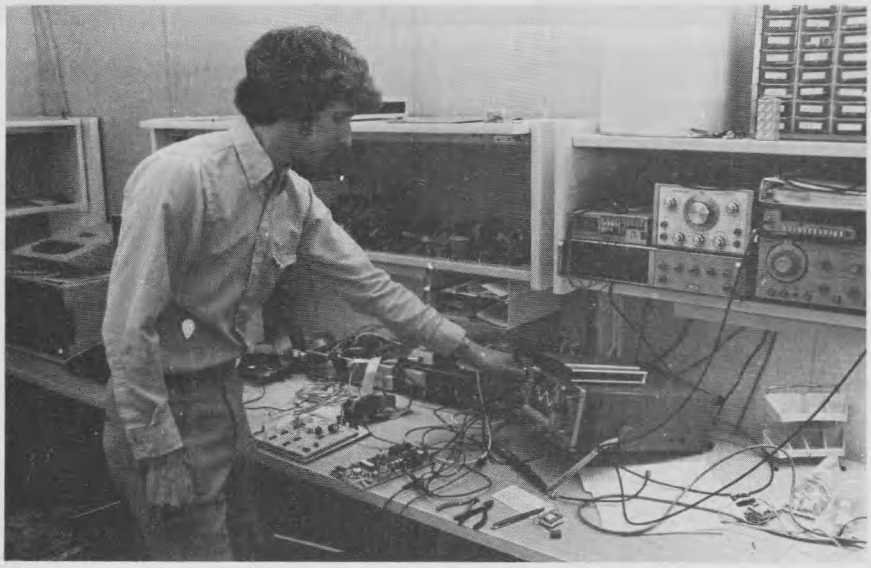
Special packet controllers that create, transmit and receive the packets are required. The packet controller boards in common use were developed by Doug Lockhart (VE7APU). They're available as bareboards from the Vancouver Amateur Digital Communications Group, 881 Rondeau St., Coquitlam, British Columbia V3J 5Z3, for $30. It costs about $250 to build the complete packet controller board.

Amateur radio operators have used packet transmission techniques on both high-frequency and very-high-frequency radio systems. Some people active in packet radio envision a North American network able to serve the data communications needs of amateur radio operators at home or on the move.

It isn't my intention here to teach you all about packet radio systems, but rather to let you know that some interesting things are happening in this area. If we ever do develop portable wrist terminals that let us access information wherever we may be, this kind of practical pioneer development work will lead the way.

More information on packet radio communications is available from several sources. The Hamnet Special Interest Group on CompuServe serves as a real-time clearinghouse for information on packet radio and other amateur radio/computer activities. Hamnet can be reached from the Special Interest Group menu.

AMRAD, the Amateur Radio Research and Development Corporation, has been very active in packet radio systems, and their monthly newsletter carries a fine Protocol column written by Dave Borden. AMRAD membership and the newsletter are available for $12 per year from AMRAD, c/o Bill Pala, 5829 Parakeet



This is the engineering lab where the Hayes products are first converted into hardware. The head hardware guru is Dale Heatherington.

Drive, Burke, VA 22015.

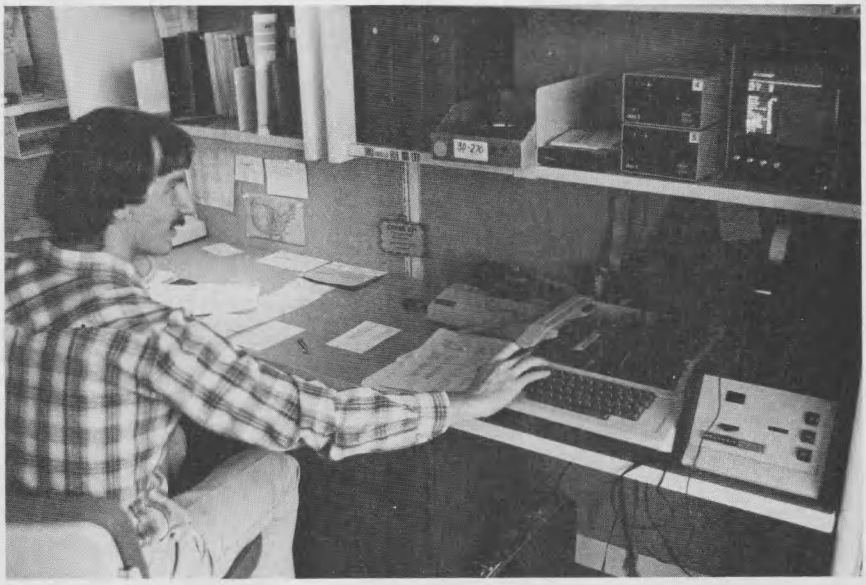
The Amateur Radio Relay League recently held a conference on radio computer networking. The printed proceedings of this conference (two volumes) are available for $5. Checks should be made payable to ARRL and mailed to 225 Main St., Newington, CT 06111.

The Vancouver club referred to above also publishes an excellent newsletter called The Packet which costs $10 per year. Packet radio systems add another dimension to the use of microcomputers as data communications devices.

A Visit to Hayes

I recently visited Hayes Microcomputer Products to see their production facilities. This company is situated north of Atlanta in a growing high technology industry area. It worked its way up by riding the success of the Micromodem II integrated modem for the Apple II computer. On the day of my visit in October, the manufacturer had just begun production of the Hayes Stack Chronograph. This chronograph is another smart peripheral that can give any computer with a serial port a clock capability. It interfaces with the Hayes Stack Smartmodem.

The world of microcomputer-based data communications systems is growing in many directions. If we haven't looked into your neighborhood lately, let me know. Send paper mail to PO Box 691, Herndon, VA 22070 (include a stamped envelope if you want a reply). Send electronic mail to TCB967 on The Source, 70003,455 on CompuServe or to the AMRAD bulletin board (703-734-1387). □



Have a problem with a Hayes product or a question on its use? David Schwartz is the customer support representative who handles problems in "real time." That Apple II at David's side is equipped with nearly every known accessory that could impact on the performance of the Micromodem II. David answers about 50 calls on an average day and probably knows the answer to any question you might have about a Hayes product. His number is 404-449-8791.

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System I specifications: Z80A, 64K Ram, 4K diagnostic Eprom, two 5" 360K drives, serial and parallel port.



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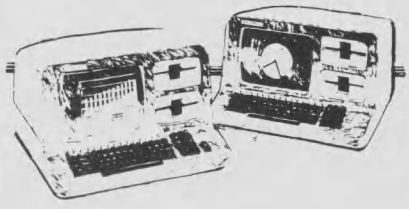
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Compiled by Eric Maloney

Greenbacks From NSF

Grants Used To Purchase Micros

Micro Grantsmanship

The National Science Foundation has become a popular source of funding for colleges and universities who want to buy microcomputers.

In fact, over half of the $3 million awarded for 1981–82 under the NSF's Instructional Scientific Equipment Program went to microcomputer- or microprocessor-based projects, says ISEP director John Maccini.

"That's what everybody's into right now," he says.

A quick scan through the list of 235 ISEP grants shows a wide range of projects, from computer laboratories to psycholinguistics experiments to science education programs. The grants—which must be matched by the institution—range in amount from a few thousand dollars to the maximum $20,000.

And the grants are not limited to large schools.

For example, Scottsdale Community College in Scottsdale, AZ, landed $20,000 for an engineering and physics lab program. The math and physics department is buying eight IBM Personal Computers to teach students in both algebra- and calculus-based physics classes about microcomputers.

"The emphasis is not on computer-aided instruction; we're more interested in having the student learn how to use the computer as a tool," says physics teacher Matthew J. Wozniak.

In one class, for instance, students are using micros to learn about analog-to-digital conversion. They do a project in which they heat a beaker of water and measure the temperature with diodes they've previously built. The signals are sent through an analog-to-digital converter to the micro, which uses the data to regulate the heater.

"It has all of the elements of a nice little feedback network, which all of our students are going to have to learn about sooner or later," says Wozmak.

In another class, students are writing programs to simulate how high a model rocket should go. Then they go out in a field and fire the rocket, and compare the predicted results with the experimental results.

"As it turns out, it's really quite dramatic," Wozniak says.

Why the IBMs? Wozniak says that the school already has ten Apples from a previous grant, and was prepared to stay with them.

"If we'd gotten the grant in July, we would have bought Apples," he says. "But then IBM came out with their computer, and it seemed to suit our needs better."

At Hampshire College in Amherst, MA, the department of language and communication has applied a $7045 grant toward the purchase of two Apples for experimental psychology work. The department also bought timing response cards and software to simplify testing.

"The software augments Pascal so that timing operations are very easy," says instructor Neil Stillings. "It's a very simple system, but important; people who need to study reaction times used to get involved in very time-consuming machine-language programming."

For example, Stillings is using an Apple to study face perception.

"I use the graphics to throw up cartoon-like figures to see if people see a face as a whole or in parts," he says. "The Apple is a great way to do this kind of study."

Stillings says that microcomputers are a boon for psychology students. "The undergraduate psychology major now has the power to do the same kinds of tests that people do at a major university with a PDP-11."

Stillings does much of his computer work on his own Apple at home, and says that a dozen or so other faculty have bought microcomputers.

"We've actually had a kind of mania here for buying these systems," he says.

Bethany-Nazarene College in Bethany, OK, also has a grant to buy two Apples for the psychology program. Dr. Forrest E. Ladd, chairman of the division of social and behavioral sciences, says they'll be used in courses on statistical methods, experimental psychology and general psychology.

The school, with roughly 1200 students, already had about 25 Apples, Ladd says, and the director of the curriculum media center is interested in programming. Micros are being used both as instructional tools and to teach computer literacy.

As is the case with many other schools, Bethany-Nazerene's computer program is largely improvisational.

"Just about everything has been done at the grassroots level," Ladd says. "There is no college policy to make all of our students computer-literate, although some of us certainly have that in mind."

Wichita State University in Wichita, KS, is using a $9501 grant to buy over a dozen microcomputers for a department of chemistry resource center. The center, which tentatively will include eight Apples, a CBM SuperPET and five or six CBM VICs, will be used exclusively by chemistry students for academic projects.

The resource center is an adjunct to another project called Computer Assessment for Undergraduate Science Education (CAUSE), says chemistry professor Melvin Zandler. Funded from previous grants, CAUSE has placed 19 Apples and seven six-foot screens in classrooms for instructional use. The screens are used very much like overhead projectors, says Zandler, "except they're dynamic: you're seeing a pictorial representation which you can manipulate."

Zandler says that the department, with some 100 majors and about 1000 students, has had a PET for about 2-1/2 years, and that the PET is "terribly overworked."

At the University of Mississippi's department of curriculum and instruction, $3631 will go toward two Apples for

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math and science methods classes. The micros will be used for computer-aided instruction, graphing and some calculating, says Jean Shaw, coordinator of elementary education.

"Students in my classes have the option of doing some project work on a micro," she says.

Other ISEP grants include:

- $3445 to Southern Baptist College in Walnut Ridge, AR, to improve science instruction.
- $1519 to California Polytechnic State University in San Luis for microcomputer peripheral aids for engineering education.
- $10,937 to Eastern Kentucky University in Richmond to "improve student learning in introductory natural science laboratories."

The 235 awards were chosen from some 1400 submissions. Each proposal was reviewed by five or six peers, and the 350 reviewers met at three different sites to discuss the submissions. Maccini and his staff made the final decisions, based on the recommendations.

By Eric Maloney
***Microcomputing* staff**

A Conduit for Courseware

In classrooms across the country, computer technology is becoming more and more accessible to students. But without quality software, all that technology leads nowhere.

Studies show that as equipment prices continue to fall, the single most important barrier to more widespread use of instructional computing is the lack of high-quality curriculum materials. Teachers may want to use computers, but often can't find good software that has been developed and tested elsewhere.

Conduit's mission is to attack this problem. A national organization associated with the University of Iowa in Iowa City, Conduit has become a respected source of computer-based instructional materials. All its courseware is reviewed for conceptual validity, usefulness as an educational tool and overall quality. Conduit also makes sure that the software is accurate, and compatible with a range of computer systems.

The organization does not itself develop materials, but tests and distributes courseware developed by others. Most of its authors are university and college faculty, and this reflects its emphasis on materials for higher education.

A typical Conduit course package consists of a computer program written in BASIC or FORTRAN, a student manual explaining the package's objectives and how to use it, and an instructor's guide giving details of how to install and use the materials on the computer. The organization's current catalog includes virtually all subject areas, from the traditional mathematics and statistics to more unexpected subjects like music and psychology.

Until recently, the 12-year-old organization worked mostly with packages for large computers or minicomputers. But the organization has expanded to include microcomputers. During the past year or so, about half its orders have been for microcomputer versions of packages, and Director James W. Johnson expects this proportion to rise. Conduit has thus been adapting existing packages for microcomputers, and encouraging authors to develop new microcomputer versions which make full use of the machines' capabilities.

Packages are being produced for the Apple II, Radio Shack TRS-80 and PET 2001, while the Atari 800 line is now being added. So far, the staff has found that about 75 percent of its microcomputer orders have been for Apple II packages; Johnson attributes this to the manufacturer's aggressive and successful marketing campaign rather than to a marked superiority in the product itself.

Conduit prefers to study a program's usefulness first. Thus, it only uses such features as animation, color graphics, game paddles and voice synthesizers when they are really needed.

Student interaction is one of the exciting potentials of microcomputers. Johnson says that while microcomputers are useful for repetitive drills, their ability to respond to a student's input and creativity is vital. He points out that students, particularly young children, are not afraid of computers, and will quickly learn to use them constructively, often more quickly than their teachers. He believes that as the new generations of children grow up comfortably with computers, computer use will become routine in all aspects of education. Although Conduit continues to emphasize the higher education market, the organization is also expanding its sales in secondary schools, where the ideas of future college students and teachers are molded. By 1985, over 50 percent of high school graduates will have been exposed to computers in education, and this in turn will lead to greater acceptance of computers at the college and university levels.

As microcomputers spread, more software distributers will enter the market, particularly educational publishers. Nevertheless, the people at Conduit believe that there is still an important place for specialized suppliers. Major publishers are more wary of taking risks. Above all, they need large orders to be viable, especially with the widespread problem of copying. Thus, many materials used in the upper-level or graduate courses cannot feasibly be produced by publishers.

In addition, publishers may not have personnel with the expertise to rethink



and redevelop courses for computer use, preferring to augment existing texts, which do not always reflect the changes in approach that computing entails. Publishers often prefer to play safe, which in the ever-changing computer field may involve lagging behind.

Johnson has many plans for the future, mapping out roles for Conduit in many aspects of microcomputer courseware. He sees a need for more complete, integrated course units. At present, Conduit tends to offer a miscellaneous range of packages which reflect the interests and expertise of the authors who submit material. Conduit would like to help authors design entire coordinated courses that are specially developed for microcomputers and that could be used in both school and home. This may involve more direct commissioning than is now done by the organization. In addition to providing an improved product, this would also help avoid duplication of effort, a growing problem.

Conduit also hopes to extend its programs dealing with serious learning problems, such as in remedial mathematics and English. Some successful experimental programs have shown that students not only respond enthusiastically to microcomputers, but also improve their skills measurably. Another area to expand will be the teaching of advanced writing skills. Microcomputers equipped with word processors and such programs as Writers' Workbench can aid writers in revising and analyzing their writing for such qualities as word variety and usage and readability.

In all areas of educational computing,

Conduit wants to emphasize the need for students to learn new skills, and to perhaps abandon some old ones. Computers can make traditional skills obsolete; is it really necessary to spend precious hours learning to calculate square roots or repeating long divisions? Instead, says Johnson, computers should be used to master the concepts behind such calculations. Students can use computer programs to sharpen their numeric skills and estimation techniques, trying out different problems and learning how to understand the results. In fact, the still uncharted area of new educational concepts in this computer age is the territory that Conduit intends to explore. Its staff see themselves as pioneers, pushing at the frontier of possibilities in educational computing.

As director Johnson writes: "We anticipate dramatic developments providing undreamed-of learning capabilities. The combination of cheap, powerful, small computers, video-disk players, voice synthesizers and broad-band communication will make it possible to bring a rich world to a student's desk. This will change how we learn and what we learn. New tools will rewrite the book on interaction and human intellect."

By Elizabeth Bird
for *Microcomputing*

Farmers Prefer Apples, TRS-80s

Subscribers to the *Farm Computer News* use mostly Apples and TRS-80s, the newsletter reported in its December issue.

The survey showed that 40.2 percent use Apples and 35.5 percent use TRS-80s. Other commonly mentioned brands included Texas Instruments, Commodore PET and IBM.

Other highlights of the survey included:

- *FCN* subscribers use their computers most for financial records, followed by livestock records, accounting and crop records.
- The kinds of software programs they need the most are financial, crop, livestock and accounting.
- Some 86 percent own a disk drive, 81.9 percent a printer, 36 percent a modem and 27.9 percent a cassette system.
- Nearly half—44.1 percent—had previous experience with computers.
- Some 95 percent own their computers, with the remainder leasing.
- About 53 percent have owned or leased their systems for less than one year.

The *Farm Computer News*, located in Des Moines, IA, is published by Meredith Corp., which also owns *Successful Farming* magazine.

VDTs and Pregnancy

At least four more clusters of miscarriages and infants born with defects have been reported by *Microwave News*. In each case, the mothers worked on or around video display terminals during pregnancy.

In addition to the now-famous *Toronto Star* case, in which four of seven infants born within a year had defects, *Microwave News* reports the following:

- Seven of 13 Air Canada employees in Montreal miscarried during one year.
- Three cases of birth defects and seven miscarriages of 15 pregnancies were reported at a defense contracting office near Atlanta in one year.
- Eight of 12 pregnancies at a Sears, Roebuck office in Dallas during a 14-month period resulted in an "adverse outcome."

Health officials feel that the clusters are simply the result of chance. Congressional investigation on VDTs and a National Academy of Sciences symposium both declared that the radiation risks are negligible. But union officials don't feel the same.

"I don't know how anyone can chalk up the clusters to chance, to a statistical quirk," *Microwave News* quotes Robert DeMatteo of the Ontario Public Service Employees Union. "They warrant very intense investigations, including radiation testing."

Microwave News reports that Bell Canada, the Open Learning Institute in British Columbia and the Ontario New Democratic Party Caucus now allow pregnant women to choose jobs that do not involve the use of VDTs.

(See "Video Dismay Terminals: Are They Hazardous to Your Health?" on p. 42 of the July 1981 *Microcomputing*.) □

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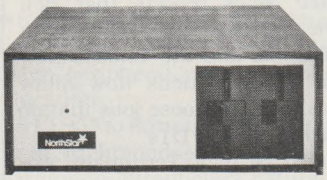
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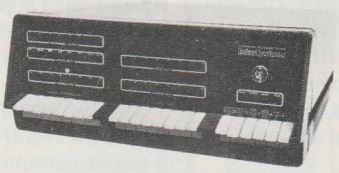
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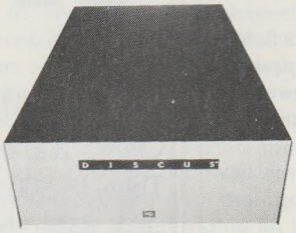
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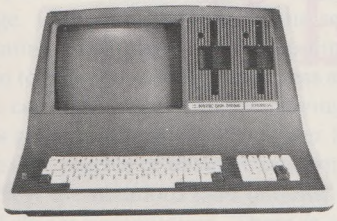
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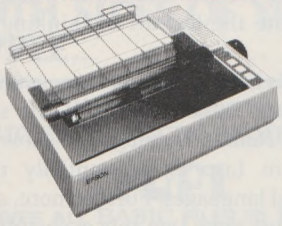
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In this and subsequent issues, Microcomputing *takes a look at languages—their applications, structure and importance to microcomputers today. We begin our survey with a look at Lisp, "a language for those who think for themselves."*

Computing, Lisp and You

By John R. Allen

Not interested in thinking? Then this article is not for you, for in the following pages we will explore two interpretations of our opening inflammatory sentence. We will explore the phenomenon of thinking to give possible explanations that might account for this human condition, and relate these hypotheses (and hypotheses they must remain, since thoughtful behavior is so seldom encountered in "the wild") to some of the characteristics one finds in Lisp. We will show that Lisp is an admirable language on which to build systems that simulate intelligence. This quest is the form—I hope, seductive form—on which we hang the substance of the article.

But wait. This is the traditional chapter of the Lisp story: Lisp as a tool for building artificial intelligence (AI) systems. Now I'm sure that most of you look on the prospects of building an AI system with the same enthusiasm that I could muster for building my own linear accelerator! There must be more to Lisp than this, for who needs yet another programming language, and a special purpose one at that? Now a Lisp person could say "Hrummpf (can YOU say Hrummpf?), that's Lisp 1.5 of 1960! Modern Lisps have data structuring capabilities that exceed the power of any other general-purpose language: strings, arrays, records, pointers and on and on through procedure objects and multiprocessing primitives.

"A modern Lisp," he would continue, "is a general-purpose language, as evidenced by its role as an implementation language for Logo, for the Honeywell EMACS text editor and for VLSI CAD systems. Besides (does he never stop!), Lisp is the only implementation language for the MIT Lisp machine; and that system includes editors, compilers, interpreters, high-speed graphics systems, micro-code assemblers, . . . everything down to the microcode is written in Lisp."

By this time you might be convinced that Lisp is a general-purpose language, useful for building any kind of complex software. Groovy, but who needs another language? We've had twenty years of "new" languages. The point now should be to consolidate and simplify the mind fuzz.

Aha! *Now* we're getting somewhere! Principles. Principles are what we're after, and Lisp is an exceptional vehicle for learning about principles of computation. For the principles of computing will endure, and those principles must be transmitted through the educational system if a truly computer-literate society is to be attained. Teaching a technology as if it were a fundamental principle is short-sighted at best and at worst fraudulent. It is the understanding of foundational issues that yields new theories, new models—new notations. And in case you feel such discussions have no practical impact, I remind you of the leverage that was obtained in the shift from the Roman to the Arabic numeral system. Though I wasn't around at the time, I have been told by reliable sources that long division using Roman numerals would be even worse than hexadecimal debugging. Consider the role of zero in modern mathematics, or look at set theory, or. . . .

Alas, there are too many "Roman languages" in our stable; these Romance languages are based on ancient ideas of sequential, numerical computation and lead to what John Backus calls the "von Neumann bottleneck." Unfortunately, this bottleneck is not just computational, it is also intellectual. We think about computing notions the wrong way. As a result there are too few *good* models of computation, and there is too little realization that there's even a problem.

This brings us to the second interpretation of the opening sentence, for if you are not interested in thinking or thinking about thinking, then we're both in for some very heavy going. It is my fervent desire to perpetuate the lost art of thinking and mind-training.

So the secret is out: this article is not just to entertain—showing how one builds AI systems in Lisp. The broader plan is to show Lisp ideas in the context of a non-Roman language—to show that "division" (whatever that is) in Lisp is substantially more understandable than in traditional languages. Furthermore, since Lisp is only mildly non-Roman, we hope that this exposure will give a beneficial boost to those who may complete the break with tradition. The instrument that carries the responsibility—the hope and the despair—is the personal computer.

For the vehicle of personal computation is a dual-edged sword, with one edge threatening to decimate the dwindling ranks of the thoughful, replacing them with masses of technologically "computer literate" consumers. Equally dismal is the prospect that the personal machine will be treated as only an extension of traditional computation, replete with traditional operating systems, traditional languages and traditional users. Finally, there's the double whammy: computers and education. If you think we had problems handling The New Math in a traditional educational setting, better hold onto your seats. The graffiti is on the wall: today's modest educational machines are treated like the horseless carriages of old, presented in the style of a simple replacement of an existing technology (paper-and-pencil now, rather than hay). What will these institutions do with the next generation of machines? And the mind boggles at the horrors awaiting something like Alan Kay's Dynabook—I can hear it now: "But does it have Basic?"

A true Pandora's box has been opened including the most dreaded of human ailments: Hope. For, on the other side of the

Address correspondence to John R. Allen, The LISP Company, POB 487, Redwood Estates, CA 95044

sword we see a glimmering promise of intellectual renewal—of tools for the stimulation of thinking, of penetrating, meaningful applications of technology to the business of improving the human condition.

Will personal computing become another pollutant like television—a technological promise unfulfilled? The key is the word personal; for if the individual has access to knowledge, one can overcome most obstacles thrown up by either a malevolent or benign institution. The critical issue then is the *mind training* necessary to assimilate existing knowledge and synthesize new knowledge. I would argue that, in the realm of computing, our most limiting constraint is not computing cycles but notation—notation to talk about computing ideas at a sufficiently high level that we can reason about them, playing the mental gymnastics that has given mathematics the power to move from the concrete to the airy heights of abstract modern mathematics.

Now the notations (and notions) of much of mathematics will not do for computation. There is a fundamental distinction between the notion of an algorithm and a mathematical function. Furthermore, theoretical notions, like the concept of a Turing machine, while theoretically sufficient, are not compelling metaphors for describing modern computation. That is basically like trying to understand a modern computer by looking at gate-level functions, or understanding creativity by studying neural activity or by doing modern mathematics at the level of set-theoretic notions.

There is a complexity gap that must be bridged, and in the past it has been a notation—a paradigm shift—that has made the difference. We desperately need that intellectual leverage in computing—that mental tool that will let us talk *about* computing on at least two levels: the level on which we can reason about computation, using theories whose validity cannot be questioned and whose value can be tested in the second level, that of computing practice. At this level we need to be able to apply the theory, confidently and comfortably relying on its validity. In the realm of computing knowledge, I would argue that Lisp-like languages currently offer the best mix of theory and practice to support that mind training. It is particularly heartening when you realize that the fundamental notions that underlie the Lisp model are no more complex than those required for a high school algebra class. With the advent of personal computing this warm glow becomes a gleeful grin: the material and perspectives requisite to building a solid computing foundation are at hand.

As you can see, this article is more than "How to Program in Lisp." It's at least "Why Program in Lisp" and, I hope, more. It touches on attitudes toward computers, thinking, artificial intelligence and education, and therefore on attitudes toward oneself. Let us begin.

If we scrape through the technological barnacles of modern hardware, what principles do we find? Physics. This is the fundamental discipline that strives to model the "real" world; to understand the nature of the universe. It is on this base that the practicalities of modern technologies are founded.

If we shovel out the Augean software stables, what do we find? We find two piles: one of applications, the other of software tools. By definition, if the applications heap contains principles, they will be those inherited from the area that spawned the applications. We must look further. Hoping the wind does not change, we examine the software tools in search of principles. We see operating systems, compilers, editors, assemblers, debuggers, parsers, scanners, . . . and, oh my, for thouands of different machines and different languages! Sigh! Discovering principles here is going to be difficult. At best we're facing a muddled branch of

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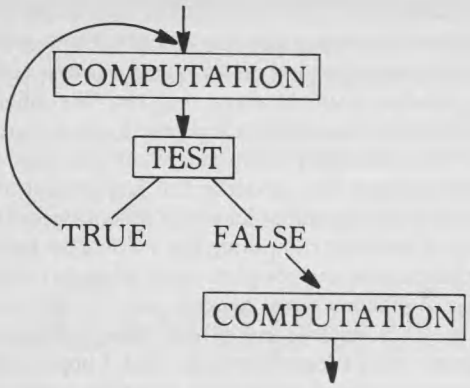


Fig. 1.

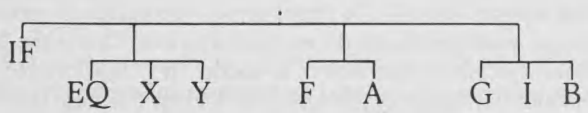


Fig. 2.

```
(IF (EQ X Y) (F A) (G I B)
```

Fig. 3.

engineering; no enduring fundamentals greet the eye yet. So first, throw out syntax. We want to examine what's being said, not how it's being said. That clears the air significantly! Shoveling madly at the other side of the pile we dispense with the multitude of machines: alas they're all alike—with the notable exceptions of the venerable Burroughs 5000 and the impudent Intel iapx432! What's interesting about these architectures? They supply structure over the flat linear bit-world in which traditional machines grovel. They have supplied hardware-level help for non-numerical computation. This is an important break with the past, where machines were primarily considered as number crunchers. Modern software and its tools have a very strong non-numerical flavor.

And what is the purpose of software tools? To transform structured objects into other structured objects. The objects manipulated by an operating system include files and programs; compilers and assemblers transform program elements into other program elements; debuggers have the ability to examine and modify errant programs. A common thread: the novel architectures and the software tools all have special sensitivities concerning program elements (we can ignore scanners and parsers since we tastefully dispensed with the syntax issue). Time to generalize: to be able to talk reasonably about program elements and their transformations, we need to highlight their salient features and need to find a reasonable notation with which to discuss those properties. Well, we have seen representations of programs as card decks or text files; hardly acceptable—they'd be indistinguishable from letters to grandma. The important ingredients in program objects are related to interrelationships: a label as a target of a GOTO; the possible branch points from a conditional action; the loopiness of a DO. If you have any doubts, reflect on the purpose of scanners and parsers to transform the linear card-image external form into something that a language processor can manipulate. The transformation invariably results in a graph structure. So our first principle is that programs should be represented and manipulated as graph structures (see Fig. 1).

Unfortunately, the development of graphical languages is technology limited; the display systems of requisite fluidity to make graphical reasoning viable are only now becoming cost effective (the Ambit family of languages is a good indication of the kind of thing that can be done). The research to supply a firm foundation for such languages has yet to be done.

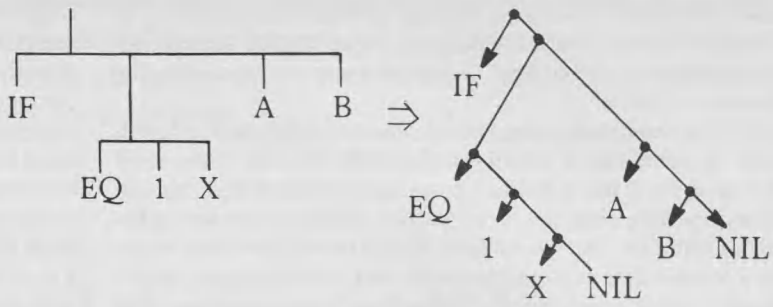


Fig. 4.

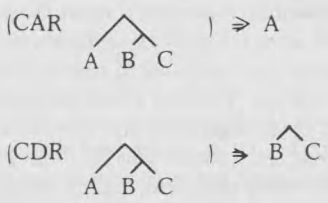


Fig. 5.

So let us retreat a bit, trying to match expectations with reality. Within the domain of graphs is a simplified object called a tree. A tree in this context is an object made up of nodes and branches subject to the restriction that no branches intersect. See Fig. 2. Such trees have a particularly nice property: they can be represented in a linear (card-image) notation (see Fig. 3).

A partial victory: we *can* represent program objects as structured objects. Can we compute with them in the same sense that we compute using traditional programs? Can we compute *on* them in the sense of writing program manipulation programs—compilers, editors, debuggers and operating systems—that manipulate these tree representations? The answer to the first question is, "Sure!" Just give me a machine architecture that runs on trees. Of course, if you don't have that, I'll be satisfied with a simulator. Such a simulator runs on a traditional machine and supplies the visage of a tree processor to the user. So we have cleverly reduced the first question to the second. Now we need a program manipulation program that simulates the execution of programs. Such a program is called an interpreter. And, of course, being obstinate, we expect that this interpreter be a tree program itself. If this discussion hasn't totally supplanted reason with mind fuzz, then try this: the interpreter runs on trees and the interpreter is a tree. So can you run the interpreter on itself? Before we can answer such a question we need to do some analysis. Informal handwaves are a poor vehicle. We need some formal notation to simplify the complexity while we study the question.

What are the fundamental operations of a tree traverser? It must be able to negotiate the branches, and be able to recognize an end node. A general tree manipulator might also have to build new trees. These operations are, respectively, known as selectors, recognizers and constructors.

What are Lisp's selectors, recognizers and constructors? Well, first, to make Lisp's job simpler, Lisp developers noted that a general tree structure can be reduced to a simpler object: the binary tree. This is a tree with only two branches at any node. (See Fig. 4. NIL is used to represent the termination nodes of the tree.)

Now in this simplified world, we need only two selectors: one for the left branch and one for the right. These Lisp selectors are

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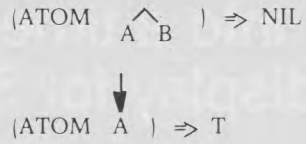


Fig. 6.

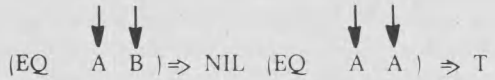


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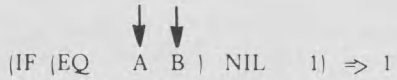


Fig. 8.

named CAR and CDR respectively (see Fig. 5).

The recognition we need comes in two flavors. First, our traverser needs to recognize when it has reached the end of a branch. The objects at these tip nodes are called atoms; thus Lisp's atom recognizer is named ATOM (see Fig. 6). Note that we represent truth and falsity by T and NIL just as some languages use 0 and 1. The other type of recognition is a form of equality testing; i.e., tell me if two atoms are identical (see Fig. 7). Notice that ATOM and EQ represent tests on tree elements; to exploit the results of these tests we need some kind of conditioned behavior. In Lisp this operation is called a conditional expression, a simplified form of which is represented in Fig. 8.

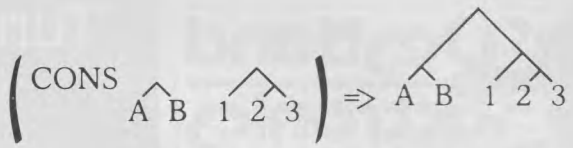


Fig. 9.

In many of our examples, we will use a decorated form of the IF:

(IF <p> then <a> else <b>)

Finally we get to the construction operation. Given two branches, construct a new binary tree. This operation is named CONS (see Fig. 9).

These are the primitive operations of the most trivial of Lisps—both a theoretical tool with which one can conjure up theories of computation and a practical tool as well, when implemented as the basis of a real production Lisp. These binary tree operations are at the same level as the bit-arithmetic of a traditional machine and only the most steadfast soul would venture into these digit dungeons. Lisp programming is almost universally done at the *list level* and most AI programming is done in languages built over this. Lisp is no longer an AI language.

So now we know why Lisp has the syntax it does: it is a tree language. One class of objects that Lisp operates on comprises tree objects and, until we have suitable graphics aids, Lisp will be seen in its parenthetical notation. Regardless of the metaphysical elegance of parentheses, what practical benefits accrue to a language that employs this tree representation rather than a more traditional syntax?

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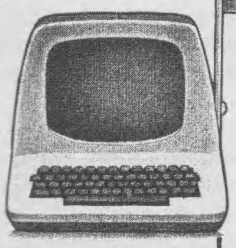
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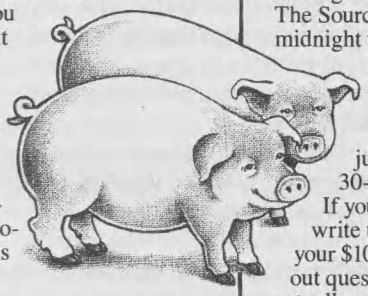
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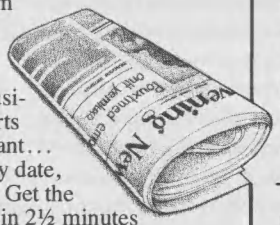
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grams in the language that directly manipulate constituents of the language. Typically, when this property of Lisp is mentioned one hears epithets like "self-modifying programs" or "unstructured code." We know already that such analysis is shallow. We've seen that compilers, debuggers and editors all manipulate programs. A more meaningful observation is that such behaviors have always been within the ability of traditional machine language. Quite right! The parenthetical notation of Lisp is just an assembly language for a tree machine. But that difference—the shift from the linear bit model of a traditional machine to the structured tree model—is exactly the kind of thing we're looking for. It gives us a boost in surrounding the complexity problem. It is unreasonable to expect one to reason coherently at the level of traditional assembly language, yet much work in the theory of computation is done at the level of Lisp. The difference is notational not computational. There's nothing computed in a Lisp program that cannot be computed in assembly language. It is exactly this area of notation that is the key to progress. We have seen it in mathematics but only seldom in the executable notations called programming languages.

In his remarkable 1979 Turing Lecture, "Notation as a Tool of Thought," Kenneth Iverson eloquently expressed the APL perspective on this issue. The Lisp perspective differs slightly. John McCarthy, the father of Lisp, mentioned in the opening address of the 1980 Lisp Conference that, besides being executable, a computing notation must be easily manipulated by a machine. This insight is the key to Lisp and the key to any flexible language. Lisp actually goes up one level in abstraction, supplying a computing notation that is easily manipulated by *itself*.

Let's go up another level in abstraction. One can surely say that any language like Pascal or Basic is a computing notation; what does Lisp purport to offer that such languages do not? The answer is *class*. Most languages treat their data items as "second-class" citizens, restricting integers to only be a certain size, or specifying that composite objects like arrays and strings may not be returned as values of procedures or disallowing programs from appearing as data objects. Such restrictions are invariably imposed because of some particular implementation difficulty such as the word size of a machine, an inadequate storage allocation system or a fixation with the stack as the ultimate run-time implementation mechanism. All of these considerations are totally irrelevant when one is looking at the language as a notation. The ideal in Lisp (achieved about 95% of the time—even in the 1960 implementation) is that any types of data object that are allowed in the Lisp implementation are allowed in a first-class fashion. They may be passed as parameters, returned as values, created, tested and manipulated with a dignified social grace due any self-respecting autonomous object. Let's look at an example from a domain that most languages purport to encompass—the integers.

Most languages, in fact, treat integers very shabbily. There are maximum and minimum values for integers, and these boundary values are most frequently a function of the machine on which the language is running. Woe onto you if your arithmetic calculation exceeds one of these bounds—your computation will be terminated, usually with a cryptic error message. However, when you think of integers as mathematical objects, no such restrictions need be made. If we seriously expect a programming language to act as a notation for thought, then obnoxious restrictions on arithmetic operations cannot be tolerated. Fortunately, most mainframe (and some micro) Lisps allow integers to be of arbitrary size, implying that the Lisp system represents integers and their arithmetic in a fashion that is independent of the underlying hardware. Of course, the Lisp system must become more complex, mediating between the constraints of the hardware and the generality of arbitrarily large integers. But this is as it should be. The user programs with *pure* objects, without undue concern for the structure of the underlying machine, and the system's implementor must supply that clean interface.

Or for a more Lisp-ish example, consider the Lisp operator CONS, which takes two tree structures and creates a new tree from these as left and right branches, respectively. If you don't like CONS, consider a Pascal-like language that allows you to generate array or record objects in a first-class fashion. In either case, an object is created dynamically; again, it is the system's job to come up with a representation for these objects. Under no circumstances should the programming notation be constrained to disallow free discussions about CONS/array objects. Later we will see what this flexibility implies at the implementation level.

This notion of representing and dealing with objects as abstract entities that possess properties is at the heart of object-oriented programming.

Consistent with our previous concern for abstraction, we generalize our stand with respect to numbers and CONS objects in the following: the objects that are present in a programming notation must be considered as abstract objects and independent of their possible implementations. This means that the only kind of operations we may perform with these objects are those that deal with the abstract characteristics of those objects. For example, numbers may be added together but addition of CONS objects is undefined. One manipulates the abstract objects with

- selectors that will allow us to select pieces of a composite object
- constructors that will mystically create a new object of a specified class.

Notice that our primordial ATOM, CAR, CDR and CONS are examples of objects in this sense.

As a first real example, we apply this object orientation to the lowly Logo turtle. A turtle has certain properties—its "turtleness." These include its shape, its horizontal screen position, its vertical screen position and its orientation. We can define a turtle object as a vector with four slots, one for each of the above properties (see Fig. 10). So, for example, we might define

(SHAPE TURTLE) = (TURTLE 1),
(HORIZ←POS TURTLE) = (TURTLE 2), etc.

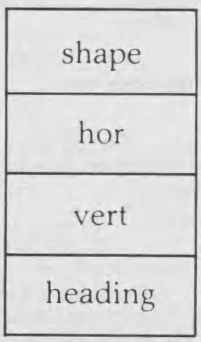


Fig. 10.

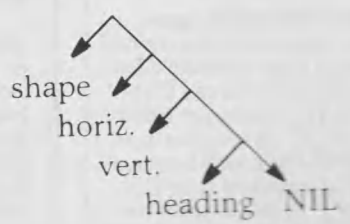


Fig. 11.

Of course if our language didn't have vectors, we might represent (according to Fig. 2) a turtle as a list. For example,

(SHAPE TURTLE) = (CAR TURTLE),
(HORIZ←POS TURTLE) = (CAR (CDR TURTLE)), etc.

Finally, we might be totally obnoxious, and represent the turtle as an integer, using some arcane encoding of heading, horizontal and vertical position.

In each of these representations we make trade-offs involving the compaction of representation, and the ease with which components can be manipulated. The point, of course, is that turtleness does not depend on the particular representation we picked; turtleness is a collection of properties of a turtle. Let's go a bit further. Assume I wanted to describe dynamic turtles—those that move about of their own volition according to some physical laws. Then I might have a fifth component that contains, say, the current velocity of that turtle. Dynamic turtles, then, are a special kind of turtles. How many turtles are there? As many as I wish. How do I distinguish between them? Give them names. But note that between turtle A and turtle B there are more similarities than differences. Both A and B are *instances* of the general notion (or class) of turtles. Note too that if I'm truly going to live in a turtle world, then my system should be prepared to deal with the life and death—dynamic creation and extinction—of turtles. In terms of language design, such desires translate into run-time object creation and are antipodal to languages that require compile-time allocation of space for objects.

The previous paragraphs touch on the static issues: the representation of turtle objects. We must also address the dynamics: how should one communicate with a turtle? In a functional (procedural) language I could write a small collection of functions, manipulating the representation of the turtle.

(FORWARD TURTLE N) = . . .,
(RIGHT←TURN TURTLE DEGREES) = . . ., etc.

Of course, these functions know about the representation, and therein lies a tale. Rather than build a system from the perspective of lots of objects being manipulated by these functions, it was observed that one could also look at the turtle communication problem as one of sending messages—let each turtle be a sovereign body and replace the small functions that operate on turtles with messages or requests that are sent to the objects. For example, if SAM is a turtle then we might write

```
(SAM MSG) = (IF (IS←FORWARD MSG)
  then . . .
  else (IF (IS←LEFT MSG) . . .
    . . . ))
```

Furthermore, instead of duplicating the message-decoding programs with each turtle, consolidate that code with an object called the turtle class. These notions—object-orientation and message-passing—are at the heart of the innovation in Logo and Smalltalk. The inclusion of the class abstraction is an insight from Smalltalk (by way of Simula). This has been a reasonably complex discussion, but I raised the issues for several reasons:

- the message-passing view of programming coupled with the abstraction of object-orientation represents a powerful paradigm shift. Though nothing new can be computed in this different perspective, certain kinds of programming problems fit very elegantly into it
- the flexibility of Lisp allows these programming methods to be incorporated easily. Thus some modern Lisps include message-passing and class hierarchy constructs
- from the point of implementation (and mathematics) the "essence" of message-passing is easily and faithfully described as an instance of our old friend: the program as first-class data object. The creation of a turtle is simply the dynamic creation of a functional object with some local state to represent the four turtle properties.

What does all this mean? First, that Lisp is a good language for implementing and describing complex systems. In reality, the first Logo and some contemporary Logos are written in Lisp. Second, it shows that the apparent simplicity of Logo turtles is illusory. There is substantial intellectual meat within the Logo model, and those who would see Logo as "just Basic with graphics" are shortchanging themselves and the children they teach. To my way of thinking, Basic and Logo are as totally dissimilar as matter and anti-matter.

For our other example of object-oriented programming we turn to a traditional Lisp domain—the description of a Lisp machine in Lisp. This means that we are able to write a Lisp function that will encode the actual process that a Lisp machine carries out when it evaluates an expression. It is appropriate to think of a Lisp machine as a calculator—type an expression on the keyboard, the machine evaluates it and the value is displayed. What kinds of expressions can be evaluated? Well, all calculators evaluate constants: type in a string of digits and the calculator translates that internally into a number. The Lisp calculator does that too: the value of a constant expression is that constant. If we wish to evaluate a complex expression like (2+3)(5-2) on a typical calculator we would have to break it into a sequence of steps: add 2 and 3, store the result, subtract 2 from 5 and finally multiply that result by the stored value. In Lisp, we can represent that complex expression as a tree and ask the Lisp machine to evaluate that tree (see Fig. 12).

We can view the evaluation process that occurs when the tree is traversed as a rat eating the fruit off the branches of an apple tree. The rodent, scurrying along the branches, retains in its internal state remembrances of previously eaten fruit. So too with the Lisp evaluator; given a complex expression, the Lisp rat will break that into a sequence of simpler sub-tasks: to eat a tree, first eat a branch; of course that branch may have sub-branches, and being a greedy rat, it wants to make sure that it misses no edible fruit; so it systematically traverses the sub-branches until it gets into the twigs that contain the fruit. Then, referring to its system, it goes to the next branch; as the twig is eaten so goes the tree.

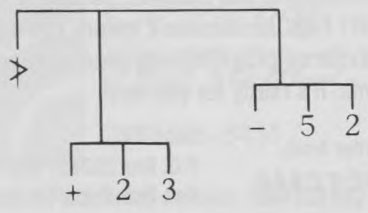
Lisp rats are abstract objects like Logo turtles. In theory, Lisp rats are particularly clean; they are called applicative rodents. This means that you will find no messy droppings (called side-effects) under the Lisp tree—only the smug animal remains. Finally, since our rat is selective, it knows to avoid wormy apples. His botanical background leads him to believe that if one apple on a branch is bad, then the rest of the branch is infected. In this case he skips the remainder of the branch and goes to the next branch.

Here is the mental structure of the Lisp rat:

```
(EAT TREE) = (EAT←BRANCH (FIRST←BRANCH TREE)
  . . .
  (EAT←BRANCH (LAST←BRANCH TREE)))
```

where FIRST←BRANCH and LAST←BRANCH are selectors, and we define

(EAT←BRANCH B) = (IF (TWIG B) then (EAT←APPLE)



```
else (EAT←BRANCH (FIRST←BRANCH B))
. . .
  (EAT←BRANCH (LAST←BRANCH B)))
```

Noting that the final lines of EAT←BRANCH are the same as the body of EAT, we can simplify EAT←BRANCH as we add the rottenness test:

```
((EAT←BRANCH X) (IF (ROTTEN X) then NIL
  else (IF (TWIG X) then (EAT←APPLE)
    else (EAT X))
```

where NIL means do nothing, look no further down the branch. We have taken a few liberties with our rat, but the basic structure of complex evaluation is here. In summary, that basic structure is:

1. If you are faced with a complex expression, break it down into smaller tasks.
2. If you are given a simple task, do it and then see if there are other tasks waiting completion.
3. There may be choices to be made about which tasks to perform.

As we apply this analysis to the task of evaluation itself, these three conditions translate as follows:

1. The primary complex Lisp task is the application of a function to some arguments. Since those arguments may also be function applications, they may require further evaluation. The Lisp regime says evaluate the arguments first (traverse the sub-trees), then apply the function to the results. This strategy corresponds to that which we tend to do when evaluating a complex arithmetic expression. In computer science, the strategy is called call-by-value. In logic, a function application is called a combination, the function is called a rator and the arguments are called rands.
2. The simple tasks of Lisp are those requesting the evaluation of a constant. Lisp constants include numbers, strings, lists, etc. In general, any kind of object allowed into Lisp will have constants.
3. The choice mechanism in Lisp is called a conditional expression. The evaluation rat will evaluate the predicate expression and, depending on the truth or falsity of the outcome, will nibble down one branch or nibble down the other—only one of the branches will be nibbled.

Here's a simple evaluator based on our tree rat's behavior:

```
(EVAL EXPRESSION) = (IF (CONSTANT EXPRESSION)
  then EXPRESSION
  else (IF (APPLICATION EXPRESSION)
    then (APPLY (FUNCTION←PART EXPRESSION)
      (EVAL←ARGS (ARGS←PART EXPRESSION))
    else (IF (IF←EXPRESSION EXPRESSION))
      then (IF (EVAL (PRED-PART EXPRESSION))
        then (EVAL (ANTE←PART EXPRESSION))
        else (EVAL (CONSEQ←PART EXPRESSION)))
```

where APPLY applies the function to the arguments and EVAL←ARGS evaluates the arguments and makes a new object representing the evaluated arguments.

Many people (and rats) find the self-describing features of EVAL puzzling. Somehow it's cheating to use the programming language to describe itself. Of course, this kind of thing happens all the time in so-called natural language. The old chestnut, "Chicago is a city, but "Chicago" is a seven-letter word," is an instance of talking about language within itself. But here there's something different; we're not just talking about language elements, we're using a process to describe that very same process. This is a deeper use of language, but not without precedent. In the early 1930s the logician Kurt Godel invented this technique to solve a knotty mathematical problem involving the self-referential nature of statements in mathematics. These questions—strange loops—are in part the subject of the book *Godel, Escher, Bach*, by Douglas Hofstadter. It is encouraging to see how transparent some of that work becomes when recast in the Lisp image—recall our earlier remarks about how an appropriate notation can clarify a complex phenomenon.

The connections between Lisp and mathematics extend deep into the Godel connection. The mechanisms that drive the computational model of Lisp are tightly coupled to the lambda calculus—a mathematical formalism that analyzed the notions of functionality. Not functionality as prescribed in the new math as a set of ordered pairs, but functionality in the more intuitive sense that we learn in high-school algebra—a function as a rule of correspondence, the functional notation, and what it means to compute values given the rule. For example, if $f(x,y) = 3x + 5(x-y)$, what is the value of $f(2,3)$? You should try this, paying particular attention to the rules that you apply as you perform the computation. The underlying rules are simple:

- Substitution: for example, if $f(x,y) = 3x + 5(x-y)$, then $f(2,3) = 3\times2 + 5(2-3)$, where we have substituted 2 for x, and 3 for y, throughout the equation.
- Simplification: for example, 3×2 may be simplified to 6. (Actually, simplification is a special instance of substitution.)

Simplification is exemplified by our current Lisp rat. Substitution, it turns out, is the heart of the matter in programming languages. It was many years before an accurate definition of substitution was given in logic; it seems to be equally problematic in computer science. Programming languages address the substitution problem when they enter the realm of variables and parameters to procedures. Rather than implement substitution directly (a costly enterprise), these languages simulate substitution by a subterfuge called binding—the association of a variable with a value in a structure called a symbol table. All too frequently this binding behavior is obscurely encoded in the inner workings of a

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language processor in such a way that the essential ingredients of the mechanism are totally clouded. Again, a notation that allows program manipulation comes to the rescue. Using Lisp's ability to manipulate the dynamic components of program execution, we can write the table lookup routine using abstract objects. In this case the objects are symbol table entries:

```
(LOOKUP NAME TABLE) = (IF (EMPTY TABLE)
  then (ERROR "undefined name")
  else (IF (EQ NAME (FIRST←ENTRY TABLE))
    then (VALUE (FIRST←ENTRY TABLE))
    else (LOOKUP NAME (ALL←BUT←FIRST TABLE)))
```

In terms of our ratomorphic model of computation, we could allow pawn tickets to appear at the terminal twigs. Our rodent would redeem these to actualize this "virtual" fruit. The business of maintaining the proper correspondences between tickets and fruit is called scoping. This issue is problematic in programming languages, because the correspondence may change as a language executes. Scoping strategies are still on trial and subject to dispute and research. Unfortunately, there is not room here for an in-depth discussion of scoping rules and their implementation. I heartily recommend the exercise, for there is no better way to understand the fundamental principles of languages and their implementation than to write the Lisp evaluator, complete with the symbol-table maintenance routines.

Let's restate our position on languages and see what we've gotten ourselves into. The point of a language is communication; the strength of a language is its expressibility. What we need in computing languages is the ability to suppress detail—to simplify complexity by abbreviation and abstraction. A simple test of a language's acceptability as a notation is: would you be able to give a compelling argument that a complex program possessed a certain property? This is not a purely theoretical concern. I believe that there is a strong correlation between notations that are amenable to proof techniques and languages that are "digestible." Lisp, APL and, perhaps, Pascal are in the latter category, while assembly language, C and Forth give heartburn; Basic is in a class by itself.

Of course, we cannot leave this section without a critique of Lisp. Its longevity, I believe, is due to its middle-of-the-road position on almost all issues. It supplies the programmer with a powerful metaphor: the tree machine. The system supplies a collection of system-building components: parser, scanner, storage management, . . . that make the job of complex software construction much easier. It is based on a clean mathematical model and therefore large classes of Lisp programs can be proved (formally or informally) to preserve desired properties. As a language system it is highly extensible, swallowing innovations like hierarchies and message passing with hardly a whimper. In fact, it has often been said that Lisp people, when faced with a new idea, simply wrap parentheses around it and say, "Look, it's been in Lisp all along."

On the negative side, Lisp does show its age. Its handling of general objects isn't quite first-class, its view of the computational world is much too sequential and deterministic and some would argue that its scoping strategy, called dynamic scoping, is in error. Proper handling of these issues is indeed difficult, and it's not clear if one could call a fixed-up language Lisp.

Probably the most serious flaw is its reliance on a sequential model of computation. This appears in two guises. First, the insistence that the computational tree be traversed in a order—we might want to have several rats all of whom could go collecting fruit in the tree simultaneously. The other constraint is more subtle and is a general feature of most programming languages. Namely, the program encodes a specific strategy for solving a problem. Frequently, there may be many ways to reach a solution, and as systems get more complex, it becomes unwieldy to explicitly encode all of the possibilities into a monolithic program. The alternative is called a goal-directed system. Here one simply adds methods for problem solving to a large database. Part of the encrypting process keys the methods, not by their name, but by the type of problem that the method may solve. The statement of the main program, then, becomes something like, "Solve the following problem, please." It is up to the system to successfully select and apply a collection of methods to solve that problem. This style of function-call is named pattern-directed invocation, meaning that a function is not called by referring to its name, but by the matching of two patterns—the pattern that describes the goal, and the pattern that describes the activity that the function can accomplish. The effect is to distinguish the problem-solving request from the space of techniques for solution. Abstract programming applied to the active program elements, like the object-oriented approach, decouples data objects from their representation.

This is a different kind of representation-independent programming in which the representation of the solution has been left free. I bring this issue up because (1) goal-directed behavior is not supported in most contemporary languages (it should be), (2) it is easy to build such systems on our Lisp base (in fact, a series of artificial intelligence languages, dating back to 1968 with Planner, have been built this way) and, finally, (3) goal-directed behavior is a reasonable model of the way we structure much of our reasoning (perhaps by formalizing part of this process we may discover better programming notations). In the next section, then, we outline a characterization of intelligent behavior, striving to model it in a Lisp (or extended LISP) world.

To begin our tour of intelligence, I suspect that most would agree that intelligent behavior has little to do with numbers.


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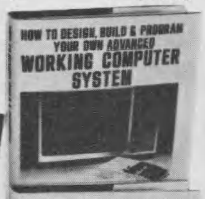
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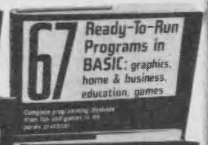


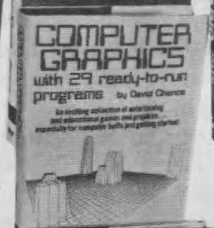


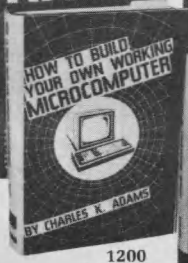
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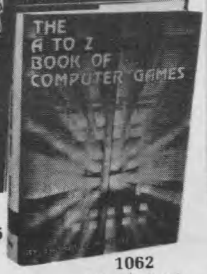


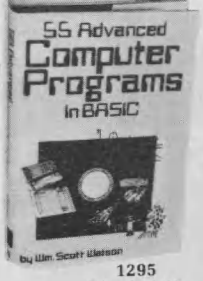














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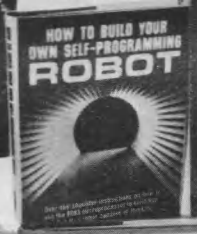
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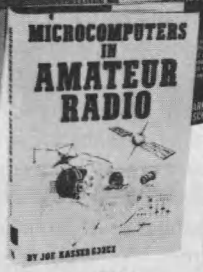


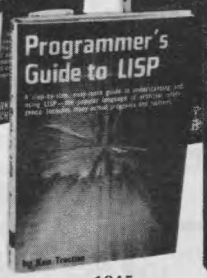
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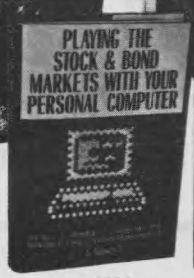
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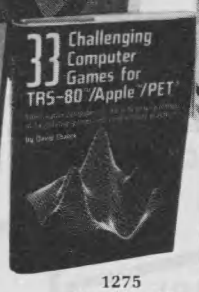


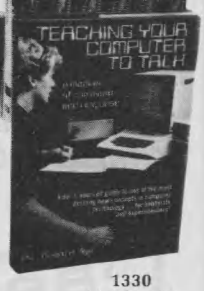












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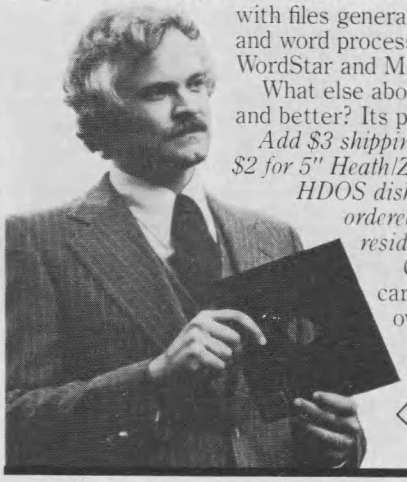
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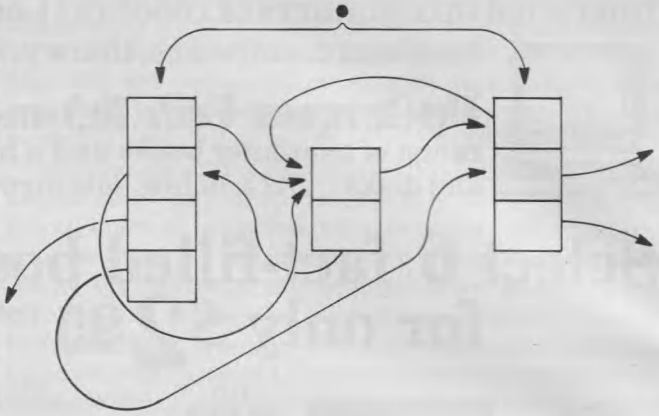


Fig. 13.

Thinking is a non-numerical activity; thinking involves dealing with interrelationships between objects—the recognition of these interrelationships and the action based on this recognition. The actions (physical or mental) are not random, but are planned. However, they are not cast in concrete. They may be modified or abandoned in the face of new information. The activity, then, is goal-directed, but exploratory and subject to change. Furthermore, a hallmark of intelligent thought is adaptation through introspection. We expect that the individual is capable of analyzing the thought process itself and modifying beliefs and actions.

Assuming that we wish to design a language that will facilitate the simulation and study of thoughtful behavior, how would these general characteristics of thought appear in our language?

- The objects manipulated by our thoughtful language should stress the notion of interrelationships. A convenient model for such objects is a graph-structure: an intertwined collection of nodes and arcs (see Fig. 13).

For example, consider the layout of a dictionary. Each definition in the book has a collection of possible meanings, and each meaning is defined in terms of other words that can be found in the dictionary. It is plausible to hypothesize a similar structuring of information within the brain, each object having a collection of information attached to it and each object in the collection referring to yet other objects, *ad infinitum*.

We recognize similarities and differences in objects by a notion of "goodness-of-fit" in a context of pattern matching. For example, a green VW, a black Ford and a black horse all have similarities and differences: all are modes of transportation, all have four contact points with the ground; some are hay-powered, some gasoline; some differ in color, etc.

- In this space of objects are the processing elements themselves. Processing elements may be retrieved, analyzed, applied and modified. Note that modification of behavior is a (very) weak form of learning.
- In exploratory creative thought the application of these active objects to the passive objects is goal-directed, not procedural: "My problem is X; what techniques do I know that will help achieve X?" Furthermore, even in mundane thought, our behavior is non-procedural in the sense that insight may divert attention to other solutions or other problems.

Several points in this characterization should bring remembrances of Lisp: the structured (not necessarily numerical) interrelated tree-structures, the program-data duality and the ability of the processing elements to manipulate both. We have already remarked that Lisp as such does not support the goal-directed behavior. However, there is a fall-back position. As a programming system, Lisp supplies some of these benefits. One does not program Lisp *in vacuo*. One programs interactively, in a style called

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middle-out, building pieces and interlocking them into larger pieces until the completed whole is before us. Debugging of thoughts and programs occurs often and interchangeably—not because the Lisp programmer is necessarily lazy, but because the task at hand is often large, unstructured and poorly understood (not just by the Lisp programmer but by humanity at large). Therefore one tends to program in an exploratory, debugging, "what-if" mode rather than the more traditional straight-laced "I have this algorithm. I need answers" mode advocated by the structured programming school. Alan Perlis is quoted as saying, "Of course you should program in a top-down manner—except for the first time." First-time thinking is never predictable, structured and regular; neither is first-time programming. Rather than berate first-time programming as being antisocial hacking, one should improve the interface, making it easier to come to a machine in the early, creative and formulative stages, while upgrading the "mind-training" phase of education, making the users sharpen their wits and, hopefully, reduce some of the mindless hacking-and-patching that can occur when a powerful tool is placed in the hands of an ill-trained operator. It is important to realize where to place the blame in cases of misuse. Do not blame the instrument, blame the operator. Debugging of thoughts is the heart of the learning process; we must encourage such behavior, not discourage it (an interesting contrast in attitudes can be had by reading Papert's *Mindstorms* and Weizenbaum's *Computer Power and Human Reason*).

Goal-directed programming, theories of debugging, descriptive computation: these are areas where, unfortunately, we do not have a good notational handle. Programming languages have tended to be prescriptive, requiring carefully prepared computational recipes. Programming languages and their methodologies tend to be fascist, advocating that the power and control is best kept within the province of the language designer, and kept out of the hands of the poor benighted programmer. These dictums are enforced by "strongly-typed" languages and heavy-handed pronouncements of doom to those who program interactively.

One promising avenue towards a foundation for goal-directed theory of computing is developing around the notion of "logic programming"—using mathematical logic as a computational vehicle. One manifestation of this proposal is the programming language named Prolog. Though this language is based on logic, it has made unfortunate compromises with the "realities" of practicality and thus dulled some of its promise. Hopefully, future logical languages will not be so impressionable. (For a discussion of Prolog, see the Ferguson article reference; for an interesting comparison to AI languages, see Kornfeld's article.)

The first real language to be built around the notion of goal-directed computation was micro-Planner, an "AI language," built in Lisp in the late 1960s. It developed from a discomfort with the effectiveness of logic as a programming formalism. Planner formalisms introduced goal-directed computation, pattern-directed function invocation and the notion of a program/database on which the computation was carried out. This pioneering work spawned a series of AI languages, and opened the chapter on languages as a key to AI problem solving. Several years later the logical foundations that gave rise to Planner spawned Prolog; and as a programming language Prolog reintroduced the notions of goal-directed, backtrack-driven computation. Hopefully, we will see a cooperative effort to develop a strong programming notation whose foundations are securely rooted in mathematics. One critical issue that must be addressed is the adequate treatment of functional objects. They must be supported in the formalism and must be manipulatable as first-class objects in the programming language.

So, as things stand twenty years later in the programming world, Lisp is still an elegant language for describing complex non-numerical problems, still a basis for a rich mathematics of computation and still the primary tool for artificial intelligence research and development. It is still a language for those who think for themselves. In the interim, Lisp has matured to incorporate a wide class of data structures and, therefore, a wide class of applications. In that interim the computing community has matured, moving from the mundane numerical computations of the early days to demands for sophisticated non-numerical processing. The old style languages and styles of thought cannot keep pace. There is a growing realization that the notions imbedded in Lisp offer important alternatives for future computing. Special hardware and micro-coded Lisp machines are being sold by LISP Machine, Inc., Symbolics and Xerox. These are high-end personal Lisp machines—$60,000 and up. Reasonable Lisps are now becoming available on microcomputers—Version 2 of (T. (L. C)) Lisp supplies object swapping for data and primitive code to mitigate against the small address space of eight-bit machines; strings, vectors, closures, streams and stack blocks to augment the simple list-world of Lisp; a window system to support graphics editors; classes, functional objects and hierarchies to support message-passing models; and compilers to supply the efficiency to completed code.The tools of thought are there, it only remains for us to think.■

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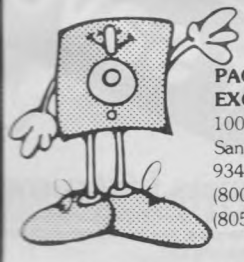
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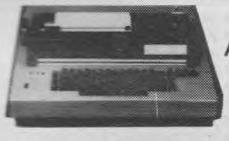
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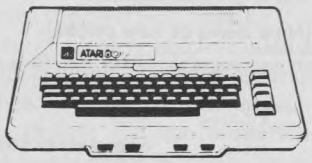
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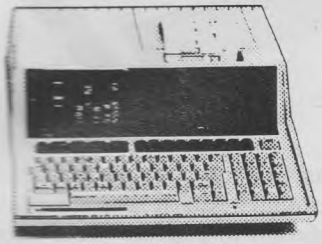
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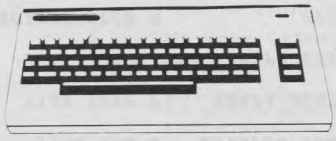
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APL may more appropriately be named A Popular Language, due to its simplicity and versatility.

A Language for Everyone

By Gary Dawkins

You've probably seen APL or know someone who uses it, but what is it—a scientific language or a language to be used in business programming? And what are all those funny symbols?

APL (A Programming Language) was invented by Kenneth Iverson, and was first used in an IBM computer around 1966. It was conceived as a notation to express ideas about computing clearly and concisely. It proved to be so concise, clear and successful that IBM decided to use it on its 360 series of computers.

APL can be easily learned and used by the non-computer scientist because you don't need to learn a great deal about bits, bytes and data declarations. You concentrate on the problem to be solved, and let APL worry about the details. This is as it should be!

The simplicity of APL leads to smaller, simpler programs that thus tend to have fewer errors.

Is this language to be used by scientists, by CPAs or by educators? The answer is yes. Exactly why the answer is yes will become clearer.

APL is popular with scientists because the notation of APL, when used for solving mathematical problems, is very similar to the mathematical notation they use. This often makes many problems trivial matters.

Business programmers often find that problems involve information that can be most easily represented in a table, or what, in APL, is called an array. An example of a three-dimensional array of information would be sales volume by each department for each month of the year for the last ten years. The array-handling power of APL helps you handle this type of information.

Educators use APL because students can get immediate positive reinforcement from their efforts. Often students can produce a useful program during the first class session

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

0 1 2 3 4 5 6 7 8 9

¨ DIERESIS	⍺ ALPHA	⍱ NOR	~ ∨
¯ OVERBAR	⌈ UPSTILE	⍲ NAND	~ ∧
< LESS	⌊ DOWNSTILE	⍒ DEL STILE	∇ ⌶
≤ NOT GREATER	_ UNDERBAR	⍋ DELTA STILE	Δ ⌶
= EQUAL	∇ DEL	⌽ CIRCLE STILE	○ ⌶
≥ NOT LESS	Δ DELTA	⍉ CIRCLE SLOPE	○ \
> GREATER	∘ NULL	⊖ CIRCLE BAR	○ -
≠ NOT EQUAL	' QUOTE	⍟ LOG	⋆ ○
∨ OR	⍞ QUAD	⌹ QUAD DIVIDE	⍞ ⍠
∧ AND	(OPEN PAREN	⍕ DEL TILDE	∇ ~
- BAR	) CLOSE PAREN	⍫ BASE NULL	⊥ ∘
÷ DIVIDE	[OPEN BRACKET	⍒ TOP NULL	⊤ ∘
+ PLUS	] CLOSE BRACKET	⍀ SLOPE BAR	\ -
× TIMES	⊂ OPEN SHOE	⌿ SLASH BAR	/ -
? QUERY	⊃ CLOSE SHOE	⍙ DELTA UNDERBAR	Δ _
⍵ OMEGA	∩ CAP	⍝ CAP NULL	∩ ∘
∈ EPSILON	∪ CUP	⍞ QUOTE QUAD	' ⍞
⍴ RHO	⊥ BASE	! QUOTE DOT	' .
~ TILDE	⊤ TOP	⌶ IBEAM	⊤ ⊥
↑ UP ARROW	∣ STILE	\ SLOPE	
⍳ IOTA	; SEMICOLON	: COLON	
○ CIRCLE	, COMMA	⋆ STAR	
→ RIGHT ARROW	. DOT		
← LEFT ARROW	/ SLASH		
SPACE	↓ DOWN ARROW		

Fig. 1. APL/V80 character set.

Gary Dawkins is vice president of Vanguard Systems Corporation, 6901 Blanco Road, San Antonio, TX 78216.

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because of the power of APL. Later on, the language does not get in the way of what is being taught.

For instance, students are taught how to sort information. Later in the course, as program complexity increases, a program might need to sort information as a subpart of the overall problem to be solved. Often it is desirable not to spend the limited class time to program the sort. Since APL has such a rich set of built-in capabilities, it is possible to let the sort capability of APL handle it, letting class time be used more efficiently.

Those Funny Symbols

What are all those funny symbols? All languages have at least some "funny symbols." BASIC, for instance, has +, −, /, *, which stand for the functions add, subtract, divide and multiply. APL, being a much more powerful language, has many more of these symbols. Fig. 1 shows the character set of APL/V80 (a version of APL implemented by Vanguard Systems Corp. on the Apple II computer). Since APL has many more functions that other languages, it follows that there should be symbols for these functions. In fact, there are more of these functions than will fit on a standard keyboard.

APL can gain additional symbols for these functions by using overstrike characters. The right-hand column of Fig. 1 shows the overstrikes. These are formed by typing the first character, backspacing and then typing the second character. This forms a new character that the language recognizes. Figs. 2, 3 and 4 show some functions that use overstrikes.

APL, being an interpretive language, has what is called an immediate execution mode. That means it is possible to sit down at the keyboard and type in some expressions without having to write an entire program. This can be done without having to go through a procedure, necessary in some other languages, of reserving memory area, defining data types and the like.

As a very simple example, suppose we want to find the sum of the first four integers. This is done much as you might expect. You simply type the numbers with the plus function between them, and then press the return key. APL adds the numbers and prints the sum. Example:

```
  1+2+3+4
10
```

We can type a similar expression to multiply:

```
  1×2×3×4
24
```

Suppose we're planning on using the string of numbers 1 2 3 4 several times. It would be helpful, especially if the string (called a vector in APL) was quite large, if we did not have to type it each time it was used. Such a vector can be assigned a name. Then the name can be referred to instead of having to type the string each time. Example:

```
NUMBERS←1 2 3 4
```

The left pointing arrow assigns the name NUMBERS to the string 1 2 3 4. Suppose we want to add 3.5 to each of the numbers. Simply add 3.5 to NUMBERS:

```
  3.5+NUMBERS
4.5 5.5 6.5 7.5
```

That was easy, but what if we wanted to add each of the numbers, as in the first example? How is that done now that we have one name, NUMBERS? APL has a way of making this easy. We use the symbol called slash, which represents an operation called reduction. We want reduction to operate with the function + and the variable named NUMBERS as follows:

```
  +/NUMBERS
10
```

+/NUMBERS is the same as 1+2+3+4.
What will

```
  ×/NUMBERS
```

produce? 24 is correct.

Note that we did not have to tell the computer ahead of time how many numbers we were going to assign or what kind of numbers they would be.

MONADIC FORM			DYADIC FORM		
SYNTAX	NAME	NOTES	F	SYNTAX	NAME	NOTES
+ A	CONJUGATE		+	A + B	PLUS	
- A	NEGATIVE		-	A - B	MINUS	
× A	SIGNUM		×	A × B	TIMES	
÷ A	RECIPROCAL		÷	A ÷ B	DIVIDE	
| A	ABSOLUTE VALUE		|	A | B	RESIDUE	
⌊ A	FLOOR		⌊	A ⌊ B	MINIMUM	
⌈ A	CEILING		⌈	A ⌈ B	MAXIMUM	
? A	ROLL	1	?			
* A	EXPONENTIAL		*	A * B	POWER	
⍟ A	NATURAL LOG		⍟	A ⍟ B	LOGARITHM	
○ A	PI TIMES		○	A ○ B	CIRCULAR	2
! A	FACTORIAL	3	!	A ! B	BINOMIAL	3
~ A	NOT		~			
			∧	A ∧ B	AND	
NOTES:			∨	A ∨ B	OR	
1. A∈⍳65535			⍲	A ⍲ B	NAND	
2. A∈0 1 2 3 4 OTHERS IMPLEMENTED AS DEFINED FUNCTIONS.			⍱	A ⍱ B	NOR	
			<	A < B	LESS	
			≤	A ≤ B	NOT GREATER	
3. GAMMA AND BETA IMPLEMENTED AS DEFINED FUNCTIONS.			=	A = B	EQUAL	
			≥	A ≥ B	NOT LESS	
			>	A > B	GREATER	
			≠	A ≠ B	NOT EQUAL	

Fig. 2. APL/V80 scalar functions.

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All we had to do was assign them. One of the great strengths of APL is that it operates on a table of information whose size or shape does not have to be fixed in advance. This allows for great flexibility in inputting information.

Suppose we had a variable such as NUMBERS, and we needed to know how many elements were in it. As you might guess, it is not hard in APL. The function shape (which is represented by the Greek letter *p*) is used to find the number of elements in a variable such as NUMBERS.

```
pNUMBERS
4
```

This tells us that there are four elements in the vector named NUMBERS. If NUMBERS had been a three-dimensional array with three planes of five rows and seven columns, then the result would have been 3 5 7.

Let us now see if we can do something useful with what we have discussed so far. We've seen only a small part of APL, so our example will be simple. Let's assume that we want to find the average dollar amount of monthly sales for the first quarter. To calculate an average, the numbers to be averaged are added together. Next, the numbers are counted to see how many there are. The average is the sum of the numbers divided by the count of the numbers.

Lets see how this is done in APL. First pick a name for the monthly sales figures and assign it the proper value. For example:

```
SALES←107832.76 118403.22 120216.78
```

The variable SALES now contains the proper numbers. The next step is to add up these numbers. Remember, we have a way of doing this by using reduction with addition. The sum would be calculated as follows:

```
SUM←+/SALES
```

The next step is to determine how many sales figures there were; e.g., what is the count of SALES?

```
COUNT←pSALES
```

All that is left to do then is divide the SUM by the COUNT.

```
AVERAGE←SUM÷COUNT
```

Then typing the name AVERAGE tells APL to display its value.

```
AVERAGE
115484.25
```

There we have the average sales figures for the first quarter. Let's put all these commands together for easier reading.

```
SALES←107832.76 118403.22 120216.78
SUM←+/SALES
COUNT←pSALES
AVERAGE←SUM÷COUNT
AVERAGE
115484.25
```

When it comes time to calculate the next quarter's average, the same procedure can be used. The only difference would be, of course, that the new sales figures would be entered.

Scientists, engineers and mathematicians find APL especially powerful and easy to use. APL notation and concepts are similar to mathematical notation. Presented without discussion is an expression that will input a list of values called X, and then compute standard deviation for the list of values:

```
(+/(X-(+/X)÷N)*2)÷¯1+N←pX←□)*.5
```

Another concept handled nicely by APL is that of the outer product (see Fig. 4). The outer product can operate on the scalar dyadic functions shown in Fig. 2. An example using the power outer product is shown below:

```
A←1 3 5 7 11
B←1 2 3
A ∘.*B
1    1    1
3    9    27
5    25   125
7    49   343
11   121  1331
```

Note that we did not have to use a loop or branching as required in other languages. All these steps can be combined into a single computer program, which in APL is called a derived function. Let's pick the name AVGSALES for the function. We will input the value of SALES, and the output will be AVERAGE.

MONADIC FORM			DYADIC FORM		
SYNTAX	NAME NOTES	F	SYNTAX	NAME NOTES	
ρ A	SHAPE	ρ	V ρ A	RESHAPE	
, A	RAVEL	,	A , A A,[K]A	CATENATE	1
⌽ V	REVERSAL	⌽	S ⌽ V	ROTATE	
⍉ M	TRANSPOSE	⍉			
		↑	S ↑ V	TAKE	
		↓	S ↓ V	DROP	
		/	V / A V/[K]A	COMPRESS	
		\	V \ A V\[K]A	EXPAND	
		[]	A[V;..;V]	INDEXING	
⍳ S	INDEX GENERATOR	⍳	V ⍳ A	INDEX OF	
		∈	A ∈ A	MEMBERSHIP	
⍋ V	GRADE UP	⍋			
⍒ V	GRADE DOWN	⍒			
		⊥	V ⊥ V	DECODE	
		⊤	V ⊤ S	ENCODE	
⍎ V	EXECUTE	2 ⍎			
		⍕	V ⍕ A	FORMAT	3
		?	S ? S	DEAL	4

NOTES: S-SCALAR, V-VECTOR, A-ARRAY (RANK 8 MAX)
K-SCALAR AXIS NUMBER, M-MATRIX

1. LAMINATION IMPLEMENTED AS A DEFINED FUNCTION
2. 255≥ρV
3. 2=ρV
4. S∈⍳65535

Fig. 3. APL/V80 mixed functions.

NEW! TPM* for TRS-80 Model II
NEW! System/6 Package
Computer Design Labs

Z80* Disk Software

We have acquired the rights to all TDL software (& hardware). TDL software has long had the reputation of being the best in the industry. Computer Design Labs will continue to maintain, evolve and add to this superior line of quality software.
— Carl Galletti and Roger Amidon, owners.

Software with Manual/Manual Alone

All of the software below is available on any of the following media for operation with a Z80 CPU using the CP/M* or similar type disk operating system (such as our own TPM*).

for TRS-80* CP/M (Model I or II)
for 8" CP/M (soft sectored single density)
for 5¼" CP/M (soft sectored single density)
for 5¼" North Star CP/M (single density)
for 5¼" North Star CP/M (double density)

BASIC I

A powerful and fast Z80 Basic interpreter with EDIT, RENUMBER, TRACE, PRINT USING, assembly language subroutine CALL, LOADGO for "chaining", COPY to move text, EXCHANGE, KILL, LINE INPUT, error intercept, sequential file handling in both ASCII and binary formats, and much, much more. It runs in a little over 12 K. An excellent choice for games since the precision was limited to 7 digits in order to make it one of the fastest around. $49.95/$15.

BASIC II

Basic I but with 12 digit precision to make its power available to the business world with only a slight sacrifice in speed. Still runs faster than most other Basics (even those with much less precision). $99.95/$15.

BUSINESS BASIC

The most powerful Basic for business applications. It adds to Basic II with random or sequential disk files in either fixed or variable record lengths, simultaneous access to multiple disk files, PRIVACY command to prohibit user access to source code, global editing, added math functions, and disk file maintenance capability without leaving Basic (list, rename, or delete). $179.95/$25.

ZEDIT

A character oriented text editor with 26 commands and "macro" capability for stringing multiple commands together. Included are a complete array of character move, add, delete, and display function. $49.95./$15.

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Z80 Text Editing Language - Not just a text editor. Actually a language which allows you to edit text and also write, save, and recall programs which manipulate text. Commands include conditional branching, subroutine calls, iteration, block move, expression evaluation, and much more. Contains 36 value registers and 10 text registers. Be creative! Manipulate text with commands you write using Ztel. $79.95/$25.

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A Z80 Text Output Processor which will do text formatting for manuals, documents, and other word processing jobs. Works with any text editor. Does justification, page numbering and headings, spacing, centering, and much more! $79.95/$25.

MACRO I

A macro assembler which will generate relocateable or absolute code for the 8080 or Z80 using standard Intel mnemonics plus TDL/Z80 extensions. Functions include 14 conditionals, 16 listing controls, 54 pseudo-ops, 11 arithmetic/logical operations, local and global symbols, chaining files, linking capability with optional linker, and recursive/reiterative macros. This assembler is so powerful you'll think it is doing all the work for you. It actually makes assembly language programming much less of an effort and more creative. $79.95/$20.

MACRO II

Expands upon Macro I's linking capability (which is useful but somewhat limited) thereby being able to take full advantage of the optional Linker. Also a time and date function has been added and the listing capability improved. $99.95/$25.

LINKER

How many times have you written the same subroutine in each new program? Top notch professional programmers compile a library of these subroutines and use a Linker to tie them together at assembly time. Development time is thus drastically reduced and becomes comparable to writing in a high level language but with all the speed of assembly language. So, get the new CDL Linker and start writing programs in a fraction of the time it took before. Linker is compatible with Macro I & II as well as TDL/Xitan assemblers version 2.0 or later. $79.95/$20.

DEBUG I

Many programmers give up on writing in assembly language even though they know their programs would be faster and more powerful. To them assembly language seems difficult to understand and follow, as well as being a nightmare to debug. Well, not with proper tools like Debug I. With Debug I you can easily follow the flow of any Z80 or 8080 program. Trace the program one step at a time or 10 steps or whatever you like. At each step you will be able to see the instruction executed and what it did. If desired, modifications can then be made before continuing. It's all under your control. You can even skip displaying a subroutine call and up to seven breakpoints can be set during execution. Use of Debug I can pay for itself many times over by saving you valuable debugging time. $79.95/$20.

DEBUG II

This is an expanded debugger which has all of the features of Debug I plus many more. You can "trap" (i.e. trace a program until a set of register, flag, and/or memory conditions occur). Also, instructions may be entered and executed immediately. This makes it easy to learn new instructions by examining registers/memory before and after. And a RADIX function allows changing between ASCII, binary, decimal, hex, octal, signed decimal, or split octal. All these features and more add up to give you a very powerful development tool. Both Debug I and II must run on a Z80 but will debug both Z80 and 8080 code. $99.95/$20.

ZAPPLE

A Z80 executive and debug monitor. Capable of search, ASCII put and display, read and write to I/O ports, hex math, breakpoint, execute, move, fill, display, read and write in Intel or binary format tape, and more! on disk

APPLE

8080 version of Zapple

NEW! TPM now available for TRS-80 Model II!

TPM*

A NEW Z80 disk operation system! This is not CP/M*. It's better! You can still run any program which runs with CP/M* but unlike CP/M* this operating system was written specifically for the Z80* and takes full advantage of its extra powerful instruction set. In other words its not warmed over 8080 code! Available for TRS-80* (Model I or II). Tarbell, Xitan DDDC, SD Sales "VERSA-FLOPPY", North Star (SD&DD), and Digital (Micro) Systems. $79.95/$25.

SYSTEM MONITOR BOARD (SMB II)

A complete I/O board for S-100 systems. 2 serial ports, 2 parallel ports, 1200/2400 baud cassette tape interface, sockets for 2K of RAM, 3-2708/2716 EPROM's or ROM, jump on reset circuitry. Bare board $49.95/$20.

ROM FOR SMB II

2KX8 masked ROM of Zapple monitor. Includes source listing $34.95/$15.

PAYROLL (source code only)

The Osborne package. Requires C Basic 2.
5" disks $124.95 (manual not included)
8" disks $ 99.95 (manual not included)
Manual $20.00

ACCOUNTS PAYABLE/RECEIVABLE (source code only)

By Osborne, Requires C Basic 2
5" disks $124.95 (manual not included)
8" $99.95 (manual not included)
Manual $20.00

GENERAL LEDGER (source code only)

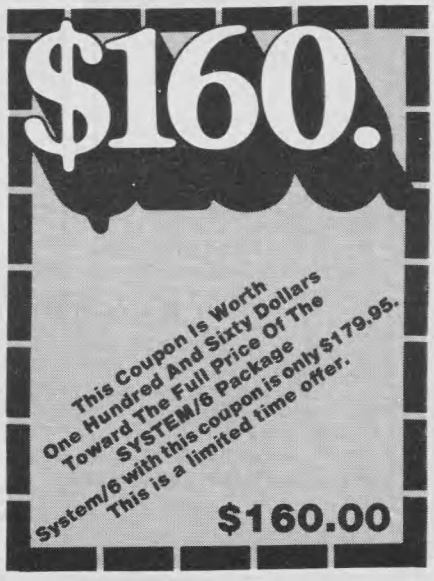
By Osborne. Requires C Basic 2
5" disks $99.95 (manual not included)
8" disks $99.95 (manual not included)
Manual $20.00

C BASIC 2

Required for Osborne software. $99.95/$20.

SYSTEM/6

TPM with utilities, Basic I interpreter, Basic E compiler, Macro I assembler, Debug I debugger, and ZEDIT text editor.
Above purchased separately costs $339.75
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4. Name, Address and Phone number.
5. For TPM orders only: Indicate if for TRS 80, Tarbell, Xitan DDDC, SD Sales (5¼" or 8"). ICOM (5¼" or 8"), North Star (single or double density) or Digital (Micro) Systems.
6. N.J. residents add 5% sales tax.

Manual cost applicable against price of subsequent software purchase in any item except for the Osborne software.

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* Z80 is a trademark of Zilog
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```
∇ AVERAGE←AVGSALES SALES
[1] AVERAGE←(+/SALES)÷⍴SALES
∇
```

The triangle-shaped symbol, called DEL, designates the beginning and the end of the function. The input to the function—i.e., the numbers we have to type in—are assigned the name SALES. The calculations are done just as in the previous example. Then AVERAGE is printed. To use the function, we would type its name followed by the sales figures:

```
AVGSALES107832.76 118403.22120216.78
115484.25
```

As you can see, this is a powerful concept and allows a great deal of work to be done with little effort. Note from Fig. 2 that the outer product can operate on any dyadic function, including logic functions. This allows simple construction of truth tables and examples from set theory. (For additional concepts, see Peelle, "Teaching Mathematics Via APL," *Mathematics Teacher,* Feb. 1979.)

Educators form a large portion of APL users. APL, being an interactive language, gives immediate feedback to the user. Students can begin to program simple functions almost immediately. It is not required to go through a long discussion of the internal workings of computers, storage devices and memory requirements before programming first. Discussions of these and other topics could begin whenever the instructor wants to introduce them, as the students begin to grasp the concepts of computing.

Some universities introduce APL as the first computer language. It can then be used as a basis for other computer science courses in such topics as data structures, numerical methods and databases. APL notation is used throughout to describe the functions of other languages.

Historically, APL has been used on large computers. Now that APL has come to small, but powerful, computers such as the Apple and TRS-80, more people will have access to it and will be able to take advantage of this powerful, general purpose language.

In an article such as this, it is impossible to cover topics in much depth. I hope I've demonstrated enough of APL so that you will delve further into this fascinating language and take advantage of the computing power it offers and the work it can do.

(For a more in depth look at APL, see *APL—An Interactive Approach*, Gillman and Rose, John Wiley and Sons, 1976.)■

OPERATOR	SYNTAX
REDUCTION	S / A
SCAN	S \ A
INNER PRODUCT	A S.S A
OUTER PRODUCT	A ∘.S A
AXIS	O [N] A FOR REDUCTION AND SCAN. AXIS ALSO APPLIES TO CERTAIN MIXED FUNCTIONS.

S - SCALAR DYADIC FUNCTION

A - ARRAY

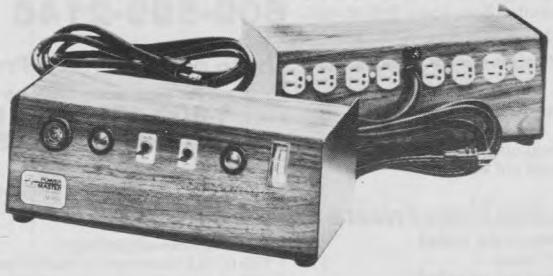
O - OPERATOR

N - AXIS

V - SCALAR OR VECTOR

Fig. 4. APL/V80 operators.

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- 25 lines (80 char./line)
- 5x7 dot matrix
- Upper & lower case
- Two 2716's (controller & char. generator)
- Serial interface RS232 & TTL
- Baud rates of 110, 150, 300, 600, 1200, 2400, 4800 and 9600
- Keyboard scanning system
- Unencoded keyboard required
- Uses +5V & ±12V Power Supplies
- Does not have graphic capabilities.

Documentation includes program listing and composite video circuit.

Bare Board only (with doc)	**$39.95**
2716 Char. Gen. A7	**$19.95**
2716 Program A12	**$19.95**

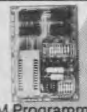
A-D CONVERTER



JBEs 16 channel A-D Converter plugs into your Apple II computer. It uses an ADC0817 which incorporates a 16 channel multiplexer and an 8 bit A-D Converter. The 16 inputs are high impedance and the voltage range is 0 to 5.12 volts. Conversion time is <100 μsec. The resolution is 8 bits or 256 steps, linearity is ± 1/2 step. Two 16 pin DIP sockets are used for input, GND & reference voltage connections. There are 3 single bit TTL inputs. Doc. Includes sample program.

81-132A Assm.	**$89.95**
81-132K Kit	**$69.95**
81-132B Bare Board	**$29.95**

EPROM PROGRAMMER



JBE's EPROM Programmer is designed to program 5V 2516's, 2532's & 2716's. It interfaces to the JBE Parallel I/O card using four ribbon cables. An LED indicates when the EPROM is being programmed. A textool zero insertion force socket is used for the EPROM. Comes with complete documentation for writing and reading EPROM's in the Apple II or Apple II Plus. Cables available separately.

80-244A Assm.	**$49.95**
80-244K Kit	**$39.95**
80-244B Bare Board	**$24.95**

PARTS

6502 MPU	**$9.95**
6522 VIA	**$9.95**
Z-80 MPU	**$9.95**
Z-80 PIO	**$9.95**
TWO 2114 RAM	**$9.95**
2716	**$14.95**
50 pin conn.	**$5.95**
Dip Jumper 2 ft.	**$4.95**

6522 APPLE II INTERFACE



The JBE 6522 Parallel Interface for the Apple II Computer, plugs directly into any slot 1 through 7 in the Apple. This card has 2 6522 VIA's that provide:

- Four 8 bit bi-directional I/O ports
- Four 16 bit programmable timer/counters
- Serial shift registers
- Handshaking

A 74LS05 is for timing. Four 16 pin sockets provide easy connections to other peripheral devices. (Dip jumpers with ribbon cables are also available from JBE) The 6522 Parallel I/O card interfaces to the JBE EPROM programmer. Understanding of machine language required to use this board. Inputs and outputs are TTL compatible.

79-295A	**$69.95** Assembled
79-295K	**$59.95** Kit
79-295B	**$19.95** Bareboard

SPEECH SYNTHESIZERS



JBEs Speech Synthesizers use the Votrax SC-01 Phoneme Synthesizer chip. The SC-01 phonetically synthesizes continuous speech of unlimited vocabulary. The SC-01 contains 64 different phonemes and 4 levels of inflection accessed by an 8 bit code. It requires 10 Bytes per second for continuous speech. Both boards have an audio amp for direct connection to an 8 ohm speaker.

Documentation includes basic user programs, a phoneme chart and listing of coded words to help you get started. Documentation for the Apple II® Speech Synthesizer includes a disk with many user programs.

81-088 Apple II Speech Synthesizer	**$139.95**
81-120 Parallel Input Speech Synthesizer	**$149.95**

Prices include the SC-01 Chip
SC-01 sold separately for **$ 75.95**

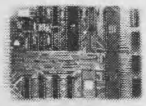
EPROM EXPANSION CARD



JBE EPROM Expander for the Apple II holds six 5V 2716s for a total of 12K bytes of EPROM. This board takes the place of the on board ROM in the Apple. It is software switchable by the same technique used by the Apple II firmware card. Solder jumpers are for reset to the Apple ROM or EPROM Expansion Card. Use JBE EPROM Programmer and Parallel I/O to program your EPROMs. EPROMs sold separately.

81-085A Assm.	**$59.95**
81-085K Kit	**$49.95**
81-085B Bare Board	**$39.95**

81-260 "SLIM"



Single board large scale Integration Microcomputer. This 4.5 x 6.5 board uses the 6502 Microprocessor, two 6522 VIA's, four 2114 RAM's, 2516, 2716 or 2532 EPROM. The fully buffered 22/44 pin bus is similar to the KIM® , SYM® , and AIM® expansion connector. The four 8 bit I/O ports connect through 16 pin dip sockets. This board was designed for control and is ideal for Personal and OEM use.

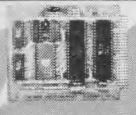
- 6502 MPU
- Two 6522 VIA's
- Four 2114 RAM's (2K bytes)
- One EPROM 2516 or 2532
- Crystal clock 1 Mhz
- Requires 5V 1AMP Power
- 4.5 x 6.5 card
- Power on reset
- Fully buffered-expandable
- Solder mask-both sides

Use your Apple II Computer, JBE 6522 Parallel Interface card and EPROM Programmer as a development system for SLIM.

Prices:

81-260A	**$199.95** Assembled
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81-260B	**$ 39.95** Bare Board

6502 MICROCOMPUTER

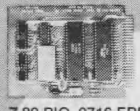


6502 MPU, 6522 VIA, 2716 EPROM, 2114 RAM single board computer. Single 5 volt power supply at 400 Ma. Two independent 8 bit I/O ports with handshake lines. RC controlled 1 Mhz clock.

Complete documentation. I/O lines use 50 pin edge connector. Data and address lines are not accessible. Mod. for 2532 is included. EPROM is not included. 1K RAM, 2K EPROM, 2 I/O ports.

80-153 Assm.	**$110.95**
80-153 Kit	**$ 89.95**
80-153 Bare Board	**$ 19.95**

Z-80 MICROCOMUTER

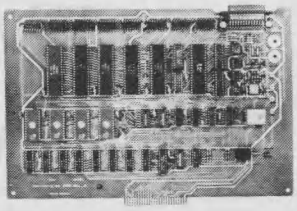


Z-80 MPU, Z-80 PIO, 2716 EPROM, 2114 RAM single board computer. Single 5 volt power supply at 300 Ma. Two independent 8 bit I/O ports with handshake lines. RC controlled 2Mhz clock.

Complete documentation. I/O lines use 50 pin edge connector. Data and address lines are not accessible. Mod. for 2532 is included. EPROM is not included. 1K RAM, 2K EPROM, 2 I/O ports.

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80-280 Kit	**$119.95**
80-280 Bare Board	**$ 19.95**

JBE I MICROCOMPUTER



JBE's 7.75 x 11.75 6502 base Microcomputer has the capacity for 16K of EPROM, 4K of RAM, 8 Parallel Ports and 1 Serial Port. Monitor and Tiny Basic are also available. The fully populated version includes:

- 1 6502 CPU
- 4 6522 VIA (8 Parallel I/O Ports)
- 1 AY5-1013 (Serial I/O Ports)
- 8 2114 RAM (4K)
- 2 2716 EPROM (Monitor & Tiny Basic)

The partially populated version includes:

- 1 6502 CPU
- 1 6522 VIA (2 Parallel I/O Ports)
- 1 AY5-1013 (Serial I/O Port)
- 2 2114 RAM (1K)
- 1 2716 EPROM (with Monitor)

Both versions include sockets for 2716s or 2532s, 8 16 pin sockets for I/O interfacing and a DB25 connector for RS232.

All address and data lines are brought off the board to the 50 pin edge connector. (similar to the Apple II bus)

This board also features power on reset and cassette interface.

81-030 C Fully Populated	**$349.95**
81-030M Partially Populated	**$249.95**
81-030B Bare Board	**$ 89.95**
2716 EPROM (with Monitor)	**$ 19.95**
2715 EPROM (with Tiny Basic	**$ 19.95**

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VISA

This author predicts that this language will have a healthy future as an important link between microcomputers and larger systems.

Is MUMPS the Cure?

By Richard F. Walters

The future growth of microcomputers will be greatly affected by opportunities for and limitations of linking them to larger systems. A coordinated plan for the orderly integration of microcomputers into the full hierarchy of computer systems will have a profound impact on their use (and sales) in the next few years.

Today's microcomputer uses are characterized by strengths and offsetting weaknesses. On the positive side, micros are reliable and highly interactive. Because of many de facto standards in operating systems (e.g., CP/M), software libraries are gradually growing. Faster eight-bit and 16-bit chips can accept (with some penalties) programs written for earlier processors, thus allowing some upward compatibility.

On the negative side, languages thus far available for the microcomputer user are not entirely satisfactory. This situation is being helped by languages such as Forth, Pascal and even Smalltalk, but so far the net results have been limited, and the potential for transfer of programs even between different types of micros has not been fulfilled.

When one considers software compatibility between microcomputers and minicomputers or large mainframes, the picture becomes even more dismal. Compilers of large machine languages as used on microcomputers usually have severe limitations that make them at best small subsets of the original article. Unfortunately, the abilities of some of the better microcomputer languages (such as Pascal) are often severely limited on larger mainframes; today's programmers thus often find that they can do more with a micro version of Pascal than is possible on much larger computers.

Many microcomputerists are engaged in other computing activities, often involving larger mainframes. A typical owner might work in a computer-related business and have his own system at home, justified in part by letting him do homework that will increase his productivity. Does the current microcomputing environment meet the needs of this group of users?

The most important features of an integrated, hierarchical system are character set compatibility, transfer compatibility of machine readable code, operating systems compatibility, and language compatibility. Unfortunately, the last three items are rarely available to the microcomputer user.

Our university environment matches in many respects the situation described above. Many of the users of shared campus computer facilities also have access to microcomputers, used mostly for word processing, accounting and laboratory instrument interface activities. The languages in use include BASIC, Pascal, subsets of FORTRAN and PL/1 and ANSI standard MUMPS.

The MUMPS Language

MUMPS is an acronym for Massachusetts General Hospital's Utility MultiProgramming System. The language has a powerful array of abilities that makes it useful in a variety of applications that go well beyond the hospital environment.

MUMPS was designed to serve many users simultaneously accessing hierarchical files consisting largely of non-numeric data. It has special strengths in character manipulation and an embedded hierarchical file structure that permits simultaneous access, with file security provisions, of a shared database.

These features make the language unique in many respects. It is an interpretive system (like BASIC, unlike FORTRAN). It has a built-in file manipulation ability that makes it similar to some database management systems. It is often used under its own operating system for greater execution efficiency. Finally, it has been used in a distributed environment, linking multiple computers together with multiple separate disk-storage systems.

MUMPS' commands may be expressed either by the complete command or by a single letter. The standard commands defined include

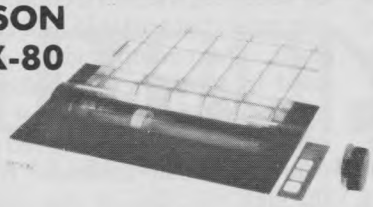
BREAK
CLOSE
DO
ELSE
FOR
GOTO
HALT
HANG
IF
KILL
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Z extensions

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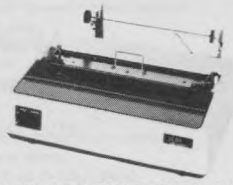
NEC GREEN 12" MONITOR JB 1201M



$159.00

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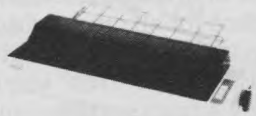
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These commands can be abbreviated (B,C,D, etc.) to save time and space. MUMPS also has a series of functions, many of which are designed to help process text data. These include $LENGTH, $PIECE and $EXTRACT. The language provides the normal arithmetic operators and, in addition, string operators for concatenation, contains, follows or pattern matching.

Variables may be used without prior declaration, and they may be subscripted to any arbitrary depth, whether or not other data elements exist elsewhere in the variable name. A unique feature of the subscripting ability is the provision for string subscripts. For example, the command

```
SET X(75876,810710,"HR")=72
```

stores the heart rate of patient 75876 as taken on July 10, 1981. The action taken by this command would be to create a single value in a hierarchical tree, requiring only enough space to accommodate the necessary subscript and value information.

MUMPS users operate within partitions that are memory-resident during a given session, allowing the use of local variables, accessible only to that user, and shared or global variables, stored on disk for use by all. Global variables are identified by a caret before the variable name (for example, ^X(1,2)).

MUMPS has two functions that permit traversing of a hierarchical file according to a sequencing convention that includes first numbers, then follows the ASCII collating sequence for all other subscript values. The $ORDER function gives the next subscript in this sequence, and $DATA function determines whether additional levels of subscripting are present.

Since MUMPS is interpretive, it has another unique feature—it can generate or modify dynamic code. A variable may be defined as any string of characters; for instance,

```
SET ABC="READ ZZZ GOTO @ZZZ"
```

In creating ABC, the computer stores the specified string. However, by using the XECUTE command, you can treat that variable as a command itself. The example given might be used in a routine that asked you to choose a term from a list supplied earlier, and then transferred program control to that location. Note that through the use of the indirection pointer reference (^ ZZZ), the program control transfers to the name supplied by the user rather than going to ZZZ itself.

A short survey article cannot convey the concepts that characterize a language such as MUMPS. But the following example, taken from a real-life situation, may give you a feeling for its abilities.

An Example

A few weeks ago I was working on a program listing with several hundred inadequately-documented variable names. I needed a listing, in alphabetical order, of all those terms, one that I could edit and update. I started to do this task manually, getting a pad of paper and reserving a page for each letter of the alphabet.

Then I thought of using MUMPS. I went to my microcomputer, wrote and tested a program to do what I wanted, and then created my list of variables, sorted alphabetically, with their definitions nicely aligned.

Before you look at the example, try to imagine whether you would seriously consider undertaking this type of one-shot program in any other language with the intent of saving time at its first (and perhaps only) use. Although the input portion might be straightforward, producing sorted output in any other language would probably be a formidable task.

Listing 1 is the program, as it was written that day. The key to the output is the last line of the program, an open-ended looping FOR clause that finds the next subscript (the term), then prints it and the value of the variable (the definition). The program ends when there are no more subscripts.

This function is so simple to write because the ASCII collating sequence is used to position variables in a balanced tree representation of the hierarchical file, so the dictionary is automatically stored in sorted form at entry by insertion at the appropriate node.

Listing 2 is a sample output from the program. This example illustrates several points. You can write, test, debug and then use a MUMPS program rapidly, so that the computer's utility is greatly enhanced. Available utility editors and run-time debugging features permit rapid identification and correction of logical or syntactical errors. Character handling functions are unusually powerful. File manipulation is a built-in feature of the language. Finally, the example selected demonstrates its use with many everyday problems.

> MUMPS has features complementary to many other microcomputer languages and unique in many important respects.

MUMPS in a Mixed Computer Environment

From this brief description, you can see that MUMPS has features complementary to many other microcomputer languages and unique in many important respects. There are, however, some other historical features of the language that make it even more attractive.

MUMPS was originally designed for minicomputers in the mid-1960s (first the DEC PDP-9, then later the PDP-11 and PDP-15). Its success in processing medical information led to new versions on several different computers. Unfortunately, each one had a distinct and incompatible dialect.

By 1972, the federal government, which had already invested large sums of money in MUMPS applications, began to study the feasibility of a new, standard language that would embody the better features of the multiple dialects then in existence. Under the able guidance of J.T. O'Neill, then with the National Bureau of Standards, and under joint sponsorship of NBS and the National Center for Health Services Research, major users undertook a cooperative effort that resulted in the adoption of Standard MUMPS in 1975. The American National Standards Institute accepted it in 1977.

Since then, MUMPS has been used on a large number of minicomputers (Digital Equipment Corporation, Data General, Harris, Prime, Tandem and many foreign manufacturers, to mention a few). Some uses

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2	ANNUI	Annuity computation program
3	DATE	Time between dates
4	DAYYEAR	Day of year a particular date falls on
5	LEASEINT	Interest rate on lease
6	BREAKEVN	Breakeven analysis
7	DEPRSL	Straightline depreciation
8	DEPRSY	Sum of the digits depreciation
9	DEPRDB	Declining balance depreciation
10	DEPRDDB	Double declining balance depreciation
11	TAXDEP	Cash flow vs. depreciation tables
12	CHECK2	Prints NEBS checks along with daily register
13	CHECKBK1	Checkbook maintenance program
14	MORTGAGE/A	Mortgage amortization table
15	MULTMON	Computes time needed for money to double, triple, etc.
16	SALVAGE	Determines salvage value of an investment
17	RRVARIN	Rate of return on investment with variable inflows
18	RRCONST	Rate of return on investment with constant inflows
19	EFFECT	Effective interest rate of a loan
20	FVAL	Future value of an investment (compound interest)
21	PVAL	Present value of a future amount
22	LOANPAY	Amount of payment on a loan
23	REGWITH	Equal withdrawals from investment to leave 0 over
24	SIMPDISK	Simple discount analysis
25	DATEVAL	Equivalent & nonequivalent dated values for oblig.
26	ANNUDEF	Present value of deferred annuities
27	MARKUP	% Markup analysis for items
28	SINKFUND	Sinking fund amortization program
29	BONDVAL	Value of a bond
30	DEPLETE	Depletion analysis
31	BLACKSH	Black Scholes options analysis
32	STOCVAL1	Expected return on stock via discounts dividends
33	WARVAL	Value of a warrant
34	BONDVAL2	Value of a bond
35	EPSEST	Estimate of future earnings per share for company
36	BETAALPH	Computes alpha and beta variables for stock
37	SHARPE1	Portfolio selection model-i.e. what stocks to hold
38	OPTWRITE	Option writing computations
39	RTVAL	Value of a right
40	EXPVAL	Expected value analysis
41	BAYES	Bayesian decisions
42	VALPRINF	Value of perfect information
43	VALADINF	Value of additional information
44	UTILITY	Derives utility function
45	SIMPLEX	Linear programming solution by simplex method
46	TRANS	Transportation method for linear programming
47	EOQ	Economic order quantity inventory model
48	QUEUE1	Single server queueing (waiting line) model
49	CVP	Cost-volume-profit analysis
50	CONDPROF	Conditional profit tables
51	OPTLOSS	Opportunity loss tables
52	FQUOQ	Fixed quantity economic order quantity model
53	FQEOWSH	As above but with shortages permitted
54	FQEOQPB	As above but with quantity price breaks
55	QUEUECB	Cost-benefit waiting line analysis
56	NCFANAL	Net cash-flow analysis for simple investment
57	PROFIND	Profitability index of a project
58	CAP1	Cap. Asset Pr. Model analysis of project
59	WACC	Weighted average cost of capital
60	COMPBAL	True rate on loan with compensating bal. required
61	DISCBAL	True rate on discounted loan
62	MERGANAL	Merger analysis computations
63	FINRAT	Financial ratios for a firm
64	NPV	Net present value of project
65	PRINDLAS	Laspeyres price index
66	PRINDPA	Paasche price index
67	SEASIND	Constructs seasonal quantity indices for company
68	TIMETR	Time series analysis linear trend
69	TIMEMOV	Time series analysis moving average trend
70	FUPRINF	Future price estimation with inflation
71	MAILPAC	Mailing list system
72	LETWRT	Letter writing system-links with MAILPAC
73	SORT3	Sorts list of names
74	LABEL1	Shipping label maker
75	LABEL2	Name label maker
76	BUSBUD	DOME business bookkeeping system
77	TIMECLCK	Computes weeks total hours from timeclock info.
78	ACCTPAY	In memory accounts payable system-storage permitted
79	INVOICE	Generate invoice on screen and print on printer
80	INVENT2	In memory inventory control system
81	TELDIR	Computerized telephone directory
82	TIMUSAN	Time use analysis
83	ASSIGN	Use of assignment algorithm for optimal job assign.
84	ACCTREC	In memory accounts receivable system-storage ok
85	TERMSPAY	Compares 3 methods of repayment of loans
86	PAYNET	Computes gross pay required for given net
87	SELLPR	Computes selling price for given after tax amount
88	ARBCOMP	Arbitrage computations
89	DEPRSF	Sinking fund depreciation
90	UPSZONE	Finds UPS zones from zip code
91	ENVELOPE	Types envelope including return address
92	AUTOEXP	Automobile expense analysis
93	INSFILE	Insurance policy file
94	PAYROLL2	In memory payroll system
95	DILANAL	Dilution analysis
96	LOANAFFD	Loan amount a borrower can afford
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have been on larger systems (Burroughs 6800-7800, PDP10/20), but its prime support to date has been at the minicomputer level.

MUMPS is uniquely suited to bridge the gap between micro, mini and mainframe systems. Designed for minicomputers it can be used on microcomputers without degradation in ability. As one of the four ANSI-approved languages, it has the compatibility necessary to guarantee true machine independence.

Because it has received significant federal support, MUMPS has been used to develop a large library of applications programs, many of them designed specifically for transport and in the public domain. These application packages include, among others, general-purpose file management systems, tutorial drivers and screen format data entry systems.

Although MUMPS is just now getting started as a tool in the microcomputer environment, its main uses thus far seem to be in the area of data entry, preparation of forms and the creation and maintenance of small data systems.

One other feature of MUMPS makes it particularly attractive for use at the microcomputer level. As noted earlier, the language consists of an interpreter and a file manager and, in some cases, resides under its own operating system. These components can be separated, and a number of people have begun to explore the use of an intelligent terminal running the MUMPS interpreter linked to larger systems which contain the shared globals portion of the language. In such a configuration, the single user response of the interpreter is guaranteed, whereas the large storage capacity and multiuser environments of larger systems can be used for their best features.

The decision to select a specific environment need not be permanent. You can start with an intelligent terminal, or with a stand-alone microcomputer MUMPS system. You can move to other, more complex, environments without either giving up your earlier investment in hardware or altering your software. This flexibility is an important factor in favor of this type of language.

In the micro environment, change is going to be with us for a long time. New processor chips, new architectures, new and more cost-effective storage devices will require perpetual rethinking of the optimal configuration even for the home computer system. MUMPS has made an important contribution to this problem too. The standardization effort led to development of some useful public domain tools. These tools have

```
LEXICON  ;PROGRAM TO CREATE SORTED DICTIONARY. RFW. 4/81.
         READ!,"ENTER NEXT TERM (NULL TO QUIT):",TERM      ;note prompt included in READ command
         GOTO:TERM=" " LIST                                ;conditional GOTO if null entry
         READ!,"ENTER ONE LINE DEFINITION: ",DEF
         SET  WORD(TERM)=DEF GOTO LEXICON                  ;use TERM as subscript, DEF as value in global
                                                             variable^WORD
LIST     READ!,"WOULD YOU LIKE TERMS LISTED (Y/N)? ",YESNO ;option to skip printing (edit file only) if no Y in
                                                             response
         SET X=" " OPEN 1 USE 1                            ;1 is printer
         FOR I=1:1 DO PRINT QUIT:X=" "
PRINT    SET Y=$ORDER(^WORD(X)),X=Y WRITE !,Y,?15,^WORD(Y) QUIT  ;sorting done automatically through $ORDER
                                                                  sequence
```

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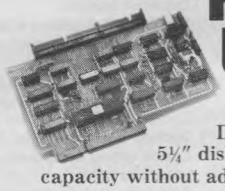
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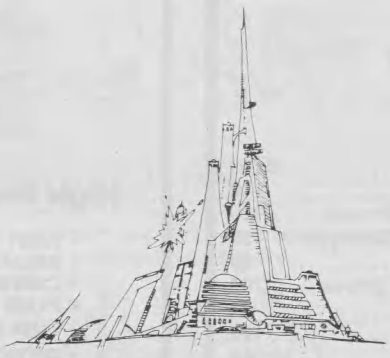
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been further improved, and in our own work we've used a technique that greatly reduces the effort needed to move to the next system. Another effort in the public domain has led to the development of a FORTRAN version, which has been used on several different types of hardware, including some large systems.

Uses of Microcomputers in a Mixed Computing Environment

All of the factors cited above would offer little benefit unless there were good reasons why the microcomputer should be used in conjunction with other systems. Let's take a look at some of the roles a microcomputer might play in a mixed environment.

First, recognizing that many microcomputer users also use larger systems, any work they can do on the microcomputer that is directly compatible with the host system expands their options. For example, developing programs on micro systems that permit exhaustive testing of logic, including the creation of expendable files, will relieve an operational system of many of the conflicts between development and operations. The guaranteed response time of a micro offers a major incentive by itself, especially when compared with systems that have reduced response at times of peak programmer productivity. Using a micro at home would probably open the door for more flexible and congenial work environments.

Micros today are heavily used as word processors. Word processing can be done well, perhaps better, on microcomputers, but is often linked to large databases, so that a downloaded application would enhance the utility of the word processing function as a whole.

```
DO  LEXICON

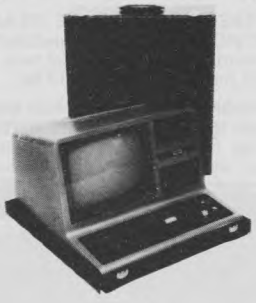
ENTER NEXT TERM (NULL TO QUIT) : CAT
ENTER ONE LINE DEFINITION : INDEPENDENT PARTIALLY DOMESTICATED FELINE
ENTER NEXT TERM (NULL TO QUIT) : ZEBRA
ENTER ONE LINE DEFINITION : HORSE WEARING STRIPED PAJAMAS
ENTER NEXT TERM (NULL TO QUIT) : BASSETT
ENTER ONE LINE DEFINITION : REGAL BUT OBSTINATE CANINE
ENTER NEXT TERM (NULL TO QUIT) : MONGOOSE
ENTER ONE LINE DEFINITION : SINGULAR ANIMAL (NO ONE CAN SAY TWO OF
  THEM)
ENTER NEXT TERM (NULL TO QUIT) :
WOULD YOU LIKE TERMS LISTED (Y/N)? Y

BASSETT     REGAL BUT OBSTINATE CANINE
CAT         INDEPENDENT PARTIALLY DOMESTICATED FELINE
MONGOOSE    SINGULAR ANIMAL (NO ONE CAN SAY TWO OF THEM)
ZEBRA       HORSE WEARING STRIPED PAJAMAS
```

Listing 2.

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• RS204

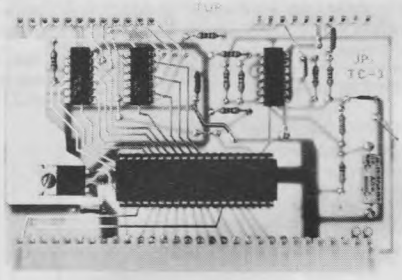
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• AP102	Apple II with Double Disk Drives	119
• AP103	Apple II, 9 inch Monitor & Double Drives	129
• AP104	Apple ///, two additional Drives & Silentype	139
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• RS202	TRS-80 Monitor or TV set	84
• RS204	TRS-80 Model III	129
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Data entry is an important, often underemphasized, aspect of most large information systems. The micro is ideal for many forms of data entry, if a link exists between it and the host system. Programs written to perform these functions can often be offloaded to micros, allowing them to increase productivity of the total system, while at the same time permitting more editing and data verification.

Data capture holds the key to successful database systems, and an effective, interactive input process will improve many conventional data entry systems.

The role of the microcomputer in a mixed environment appears guaranteed throughout the useful life of the system. Microcomputers may be used to develop and demonstrate prototype systems. These systems, once accepted or expanded, can be transferred to a larger system, but a portion of the function may be left behind, or new functions may be taken on by the micro in an expanded configuration. At no point does it appear that the micro will lose its uses in such an environment, if language compatibility is maintained.■

Information on commercial implementations of MUMPS on microcomputers is available from the following sources:

6809 microprocessor

David Brown
Comp Consultants, Inc.
6510 Fannin, Suite 307N
Houston, TX 77030

Micronetics Design Corp.
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LSI 11/23 microprocessor:

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Hudson, MA 01754

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Bala Cynwyd, PA 19004

Intersystems, Inc.
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North Boston, MA 02110

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Amherst, NH 03031

Patterson, Gray and Associates
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Arlington Heights, IL 60005

Data General Micronova:

Innovative Computer Systems, Inc.
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Denver, CO 80022

Z8000 (Onyx)

David Bridger
6943 Waterman
St. Louis, MO 63130

There are two public domain versions, available for distribution costs:

LSI 11:

Dr. Kevin O'Kane
Dept. of Computer Science
University of Tennessee
Knoxville, TN 37916
(approximate distribution cost: $25)

8080/Z80 under CP/M

Dr. Richard F. Walters
Dept. of Community Health
University of California
Davis, CA 95616
(distribution costs: one time disk: $33; one year update subscription: $93)
(Note: This version also available for Apple with language card and memory extension; North Star and Superbrain minifloppy systems, and other CP/M-compatible configurations. For further information, write Dr. Walters.)

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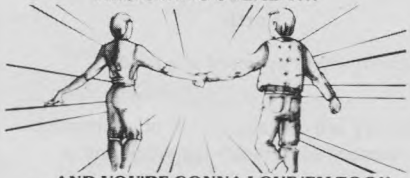
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If you're about to hit the Forth highway, take this traveller's guide with you.

Forth for the Novice

By Art White

	Machine-Language Program	Forth Program
1.	A section of memory contains the program.	A section of memory contains the program.
2.	To select the program, the Program Counter (PC) is set to the first memory address of the program.	To select the program, the Interpretive Pointer (IP) is set to the first memory address of the program.
3.	The PC is then incremented, one memory address at a time.	The IP is then incremented, one memory *cell* at a time.
4.	The contents of the memory addresses pointed to by the PC constitute the instructions for the processor.	The contents of the memory cells pointed to by the IP constitute links to the instructions for the processor.
5.	To jump to another block of memory addresses, the PC is loaded with the starting address of the new block where the incrementing action of the PC continues.	To jump to another block of memory cells, the IP is loaded with the starting address of the new block where the incrementing action of the IP continues.
6.	If the jump happens to be a call, the address following the call instruction is saved on the stack. When this address later is placed back into the PC, a return has taken place.	In the Forth equivalent of a call, the address of the memory cell following the call instruction is saved on a return stack. When this address later is placed back into the IP, a return has taken place.

Table 1. The PC and the IP perform the same function—they execute the program step by step.

	Other Language	Forth
1.	One memory address is accessed at a time.	One memory *cell* is accessed at a time.
2.	One memory address contains eight bits of information—the work unit is eight bits.	One memory cell contains 16 bits of information (=two memory addresses)—the work unit is 16 bits.
3.	The PC is automatically incremented internally within the processor chip.	The IP is incremented by a software routine. This routine is called NEXT.

Table 2. This refers to an eight-bit microprocessor.

Most of the articles about the Forth language are written for the seasoned programmer. I offer instead a glimpse of the basic mechanics of Forth, aimed at those of you who just want to learn your way around. I have used FIG-Forth Release 1.1, 15 Sept. 79, by Forth Interest Group, PO Box 1105, San Carlos, CA 94070, as a model. The FIG-Forth terminology and procedures may vary from other Forth standards, but will serve to illustrate the principles involved.

A Forth program is executed much like a machine-language program. (See Table 1 and Fig. 1.) Because the normal stack is used heavily in Forth, a second stack is used for a return stack. This heavy use of the stack in Forth is one of the operating features which makes Forth unique.

The stack is where data, addresses, flags and other things used by the program (these are all lumped under the word parameters) are placed for easy availability when being passed from one portion of a program to another. But it could also be considered the Forth equivalent of the accumulator. Data which would otherwise be input to an accumulator is, in Forth, placed on the stack. Software routines perform the normal internal accumulator functions, and the result—data, flags or whatever—is placed back on the stack for use by the program.

A few differences between Forth and other microcomputer languages are outlined in Table 2.

Address correspondence to Art White, 1371 Nashville St., San Diego, CA 92110.

To simplify the computer's workings for the people who use it, the address in memory where each routine starts is customarily given a label, or name, and the routine itself is referred to by this name. Names are words, and in Forth each routine is referred to as a word. A group of words can be combined in a sequence to perform a task, and this group of words can be called by its own name.

To assist Forth in its bookkeeping, each word follows a format (see Fig. 2). The name field is handy when Forth is searching for a word in its dictionary—the section of memory where these words are located. The dictionary section of memory is illustrated by the example in Fig. 3.

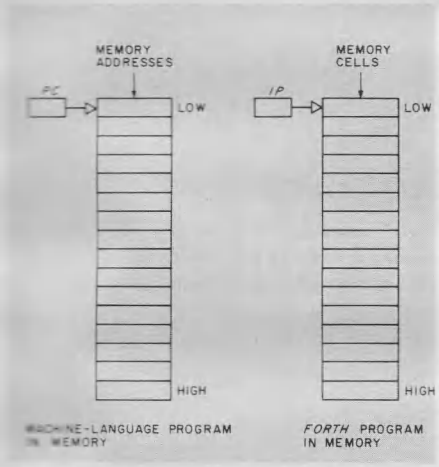


Fig. 1. Forth follows the same format as machine language. The PC is incremented within the processor. The IP is incremented by the software routine called NEXT.

These words are usually of varying length, depending on the length of the name and the contents of the parameter field. The link field and the code field are always one memory cell each. Words added more recently to the dictionary appear at the higher memory addresses. One nice thing about Forth is that most of these words are short.

Forth identifies a word by means of its name field, which also follows a format. Forth recognizes a word by checking the number of characters in the name and checking each character in the name individually. If the word is CAMERA, the name field will look like Fig. 4.

The first byte is the length byte, and contains the number of characters in the name (see Fig. 5). Each following byte contains a character of the name. In searching for a word, Forth checks each byte in turn. If there is no match, it continues on to the next word.

The smudge and precedence bits are of no concern at this point, so I'll just note that they exist. The link field is employed so that Forth can go from word to word in the dictionary until it finds the word it is looking for. The link field contains the name field address (NFA) of the previous word in the dictionary. Forth starts with the latest word added to the dictionary (high memory address) and works towards earlier words at the lower memory addresses. (See Fig. 6.)

The link field of the earliest word in the dictionary contains all zeros, which tells Forth that the search is ended and the word it is looking for is not in the dictionary.

This search procedure—going from word to word, checking the length of the name and checking for a match of all the characters of the name—uses routines which are controlled by NEXT and which involve the IP and PC, just as other routines do. This search procedure shows how a word can be found in the dictionary, if its name is known, through the teamwork of the name and link fields.

Dictionary words can also be accessed in another way, which is normally used when a program is running. It requires neither the name field nor the link field, and functions independently of them. Accessing in this way is principally the task of the IP and the NEXT routine.

How It Works

One function of NEXT is to increment the IP. After this has been done, the IP points to the next memory cell. This memory cell contains the address of the code field (CFA) of the

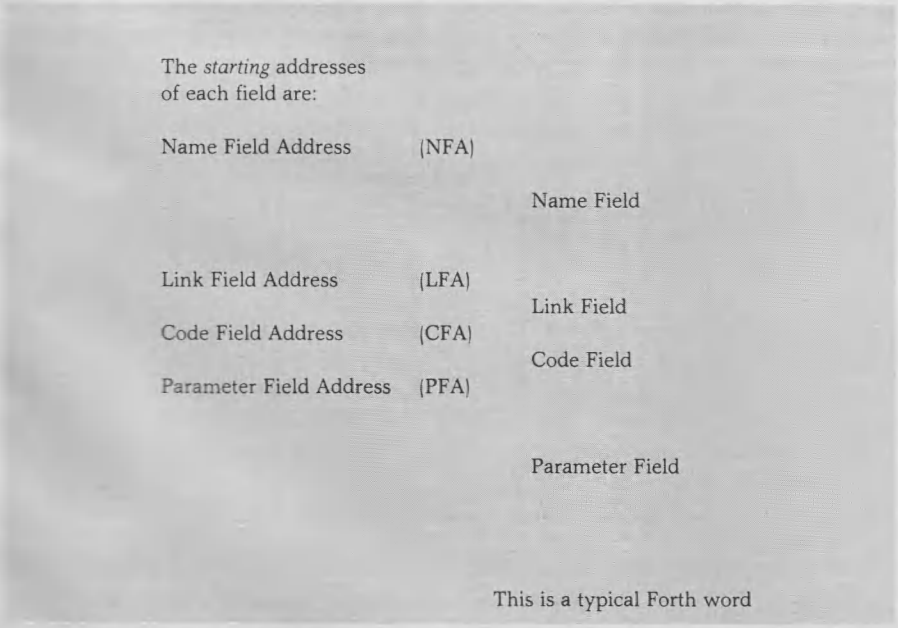
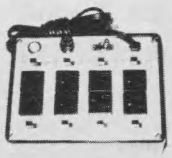


Fig. 2. Every Forth word contains the same four elements (fields). Each element has its own function to perform and an appropriate time to perform it.

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next word to be executed. It is called the code field because it *always* points to a section of memory where there is machine language (code) to be executed. (See Fig. 7.)

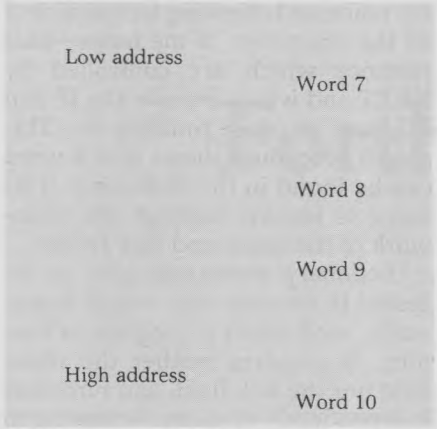


Fig. 3. Forth words are added consecutively in the dictionary part of Forth memory in the order in which they are created.

Byte 1	6
Byte 2	C
Byte 3	A
Byte 4	M
Byte 5	E
Byte 6	R
Byte 7	A

Fig. 4. This is the format for the name field of a Forth word. The number of bytes varies with the size of the word, and all bytes must be identical to match. (Some Forth fans like to store, for example, only the first three letters of the name to save memory space and time. The above word would then consist of the first four bytes, as shown.)

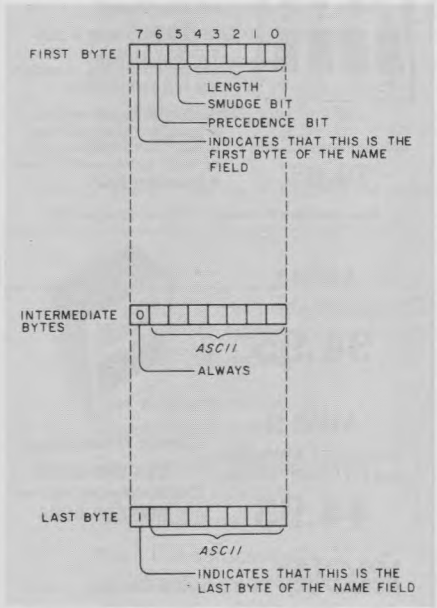


Fig. 5. Bit 7 is high on the first and last bytes. All bytes following the length byte contain ASCII characters.

When the IP is incremented again, another word is chosen. Thus, through the stepping of the IP, words are chosen in sequence to perform the various chores required by the program.

The memory cell the IP points to is often called the word pointer because, in choosing its associated word, it too functions as a pointer. Remember that a pointer contains the address of what it is pointing to.

The content of the parameter field defines the word. The content of the code field is dictated by the content of

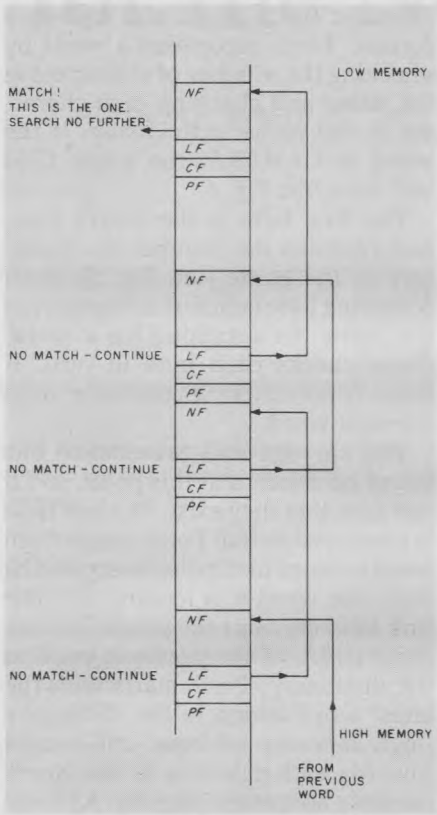


Fig. 6. A word has been entered into the input stream of Forth by keyboard or disk. From the last word entered in the dictionary back to the first word, Forth checks each name field in turn for a match. The link fields tie all the words in the dictionary together.

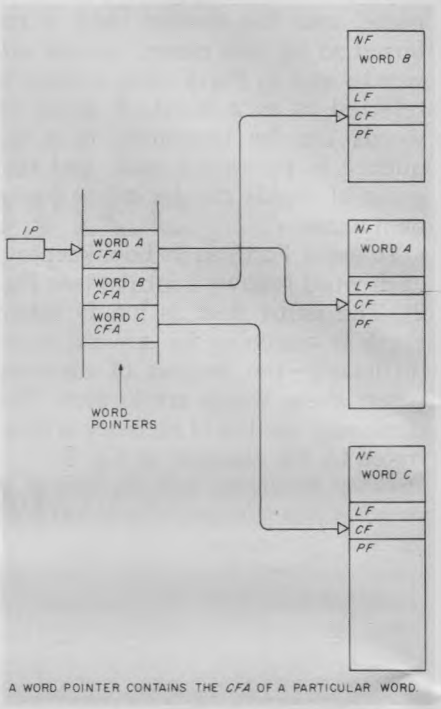


Fig. 7. Regardless of where a word is physically located in memory, it is easily selected by its code field address when the IP points to it.

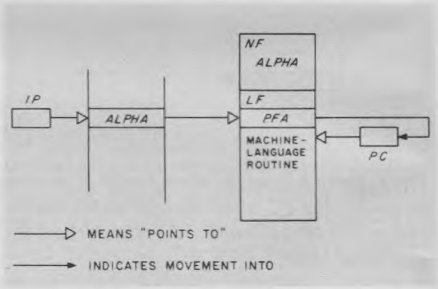


Fig. 8. When the IP points to a word, the PC in every case is set to the beginning of a machine-language routine.

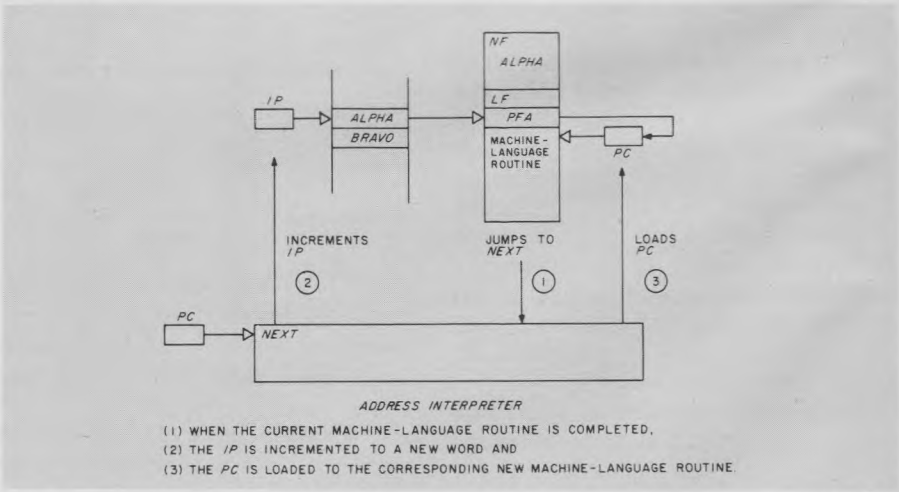


Fig. 9. NEXT *is the software routine that increments the IP. The consequence of incrementing the IP is that a new CFA is selected, which results in the PC being set to the machine-language routine appropriate to the word selected.*

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	74LS136	.50	74LS275	3.30	4008	.95	4046	.95	4507	.95
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	74LS153	.75	74LS298	.95	4015	.95	4053	.95	4516	1.50
	74LS155	.90	74LS299	2.50	4016	.45	4055	2.75	4518	1.25
	74LS156	.90	74LS323	3.95	4017	.95	4056	2.75	4519	1.25
	74LS157	.75	74LS324	1.75	4018	.95	4059	9.95	4520	1.25
	74LS158	.75	74LS347	1.95	4019	.45	4060	1.25	4522	1.25
	74LS160	.90	74LS348	1.95	4020	.95	4066	.75	4526	1.25
	74LS161	.90	74LS352	1.50	4021	.95	4068	.40	4527	1.75
	74LS162	.90	74LS353	1.50	4022	.95	4069	.40	4528	1.25
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4007	.35	4044	.85	4506	1.25				
4008	.95	4046	.95	4507	.95				
4009	.45	4047	.95	4508	1.95				
4010	.45	4048	.75	4510	.95				
4011	.35	4049	.55	4511	.95				
4012	.35	4050	.55	4512	.95				
4013	.45	4051	.95	4514	2.25				
4014	.95	4052	.95	4515	2.25				
4015	.95	4053	.95	4516	1.50				
4016	.45	4055	2.75	4518	1.25				
4017	.95	4056	2.75	4519	1.25				
4018	.95	4059	9.95	4520	1.25				
4019	.45	4060	1.25	4522	1.25				
4020	.95	4066	.75	4526	1.25				
4021	.95	4068	.40	4527	1.75				
4022	.95	4069	.40	4528	1.25				
4023	.35	4070	.40	4531	.95				
4024	.75	4071	.30	4532	1.75				
4025	.35	4072	.30	4539	1.75				
4026	1.95	4073	.30	4543	1.95				
4027	.65	4075	.30	4553	4.95				
4028	.80	4076	.95	4555	.95				
4029	.95	4078	.50	4556	.95				
4030	.45	4081	.40	4558	2.25				
4031	1.50	4082	.40	4568	5.95				
4032	2.75	4085	.95	4581	1.95				
4033	2.75	4086	.95	4582	1.95				
4034	2.75	4093	.95	4584	.95				
4035	.85	4094	3.95	4585	.95				
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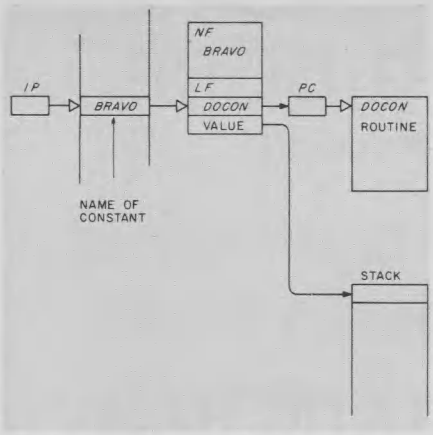


Fig. 10. When the IP points to the name of a constant, the value represented by that name is placed on top of the stack. The PC points to the machine-language routine that does the job.

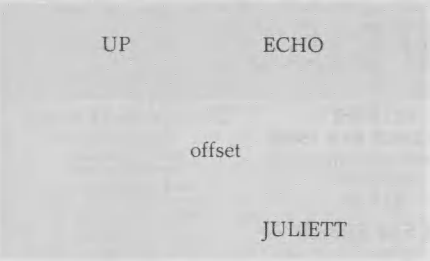


Fig. 11. User variables differ from other Forth variables in that they are standard with the system and are listed in a user table. A particular variable is accessed by adding its offset to a base memory address.

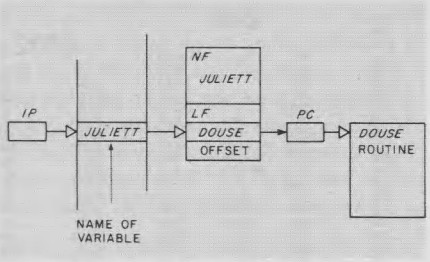


Fig. 12. The task of taking the offset value furnished by JULIETT and moving the value thus accessed from the table to the top of the stack is done by the DOUSE routine.

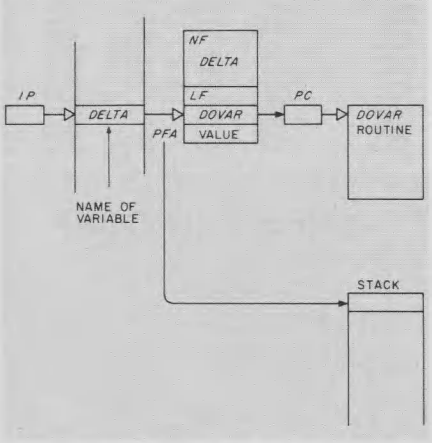


Fig. 13. The purpose of the DOVAR routine is to move the address of the value contained in the parameter field of DELTA to the top of the stack.

the parameter field. That is, for each type of parameter field there is a corresponding address in the code field.

For example, a parameter field may contain one of the following:

- a machine-language routine (code)
- a constant
- a variable
- a list of previously defined words

Some examples follow.

If the parameter field of the word contains a machine-language routine, the code field of that word contains its own parameter field address (PFA). The size of the parameter field is equal to the size of the machine-language routine it contains; in fact, the parameter field *is* the machine-language routine. (See Fig. 8.)

When NEXT loads the PC with the PFA, the machine-language routine of the parameter field is executed. The final action of the machine-language routine is to load the PC with the address of NEXT.

This is probably a good spot to mention the address interpreter, which is essential to the topic. Using my last example again, the address interpreter might be illustrated as shown in Fig. 9.

The actions shown in Fig. 9 are taking place all the time that Forth is turned on, regardless of the type of word selected by IP and regardless of the name of the program that is being executed. A program is *always* being executed so the address interpreter is always functioning.

In the case of a constant, the parameter field consists of a single memory cell containing the value of the constant. The code field contains an address which is always the same—that of a machine-language routine which FIG-Forth has labelled DOCON (do constant routine?). When this address is loaded into the PC by NEXT, the routine moves the value of the constant contained in the parameter field to the top of the stack. (See Fig. 10.)

The final act of the routine is to load the PC with the address of NEXT.

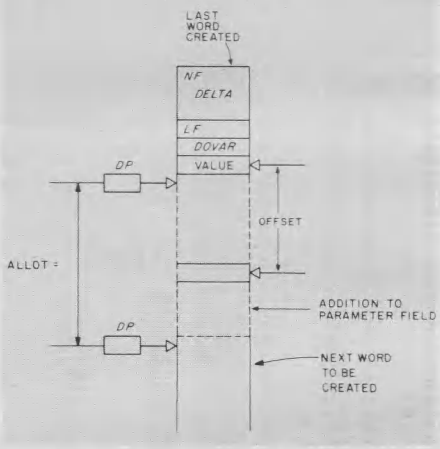


Fig. 14. Simply adding a value to the dictionary pointer (DP) so that the next word to be created starts further down in memory (at a higher memory address) has the effect of leaving space for an array of values.

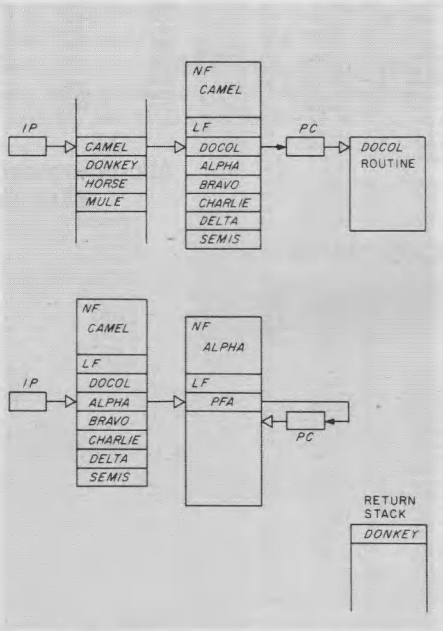


Fig. 15. This illustrates the key to a basic and often repeated action in Forth. It consists of putting a new value in the IP, and saving the old value to come back to.

One type of variable, called a user variable (see Fig. 11), consists of an area of memory where values are stored. The user pointer (UP) points to a base address. To access a desired memory cell, an offset value is added to the base address. This is the task of DOUSE (do user routine?), which then places the sum of the UP and the offset value onto the top of the stack. It then loads the PC with the address of NEXT (see Fig. 12).

In another type of variable, the parameter field consists of a single memory cell containing the value of the variable. The code field contains an address which is always the same—that of a machine-language routine that FIG-Forth has labelled DOVAR (do variable routine?). (See Fig. 13.)

When this address is loaded into the PC, DOVAR moves the address of the parameter field to the top of the stack. The address containing the variable, rather than the variable itself, is moved so that arrays (and

strings) can be handled easily. Forth "expects" to find the address of the variable on the stack and is able to process it. DOVAR ends by loading the PC with the address of NEXT.

One of the values stored as a user variable is a dictionary pointer (DP). The DP contains the address of the next available space in the dictionary. It is updated each time a new word is created. Among other things, it is useful in the creation of an array.

An array is a list of variables. Forth handles an array in a forthright manner by increasing the size of the parameter field of a single variable to accommodate the additional variables.

The Forth word ALLOT adds the value selected by the programmer to the DP. The next new word will start at the new address of the DP, and the parameter field of the single variable has been effectively increased. To access a particular memory cell of the array, add the amount of its offset from the PFA to the PFA. This is illustrated in Fig. 14.

An important feature of Forth is that once a word exists in the dictionary, it is there to be used. A later word can use an earlier word as part of its definition. A new task-performing word can be added to the dictionary by using words already existing in the dictionary. The words already existing are called previously defined words.

For words consisting of previously defined words, the code field contains the address of a machine-lan-

Type:	CODE	**For:** a machine-language routine
	CONSTANT	a constant
	VARIABLE	a variable
	USER	a "user" variable
	:	begin a new word definition
	;	end a definition

Table 3. A list of common compiling words.

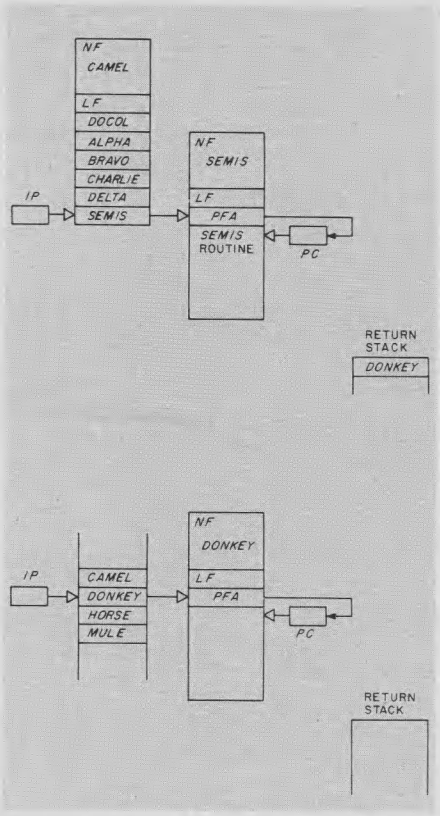


Fig. 16. The value saved on the return stack is placed back into the IP, so it can continue from where it left off (when DOCOL was executed).

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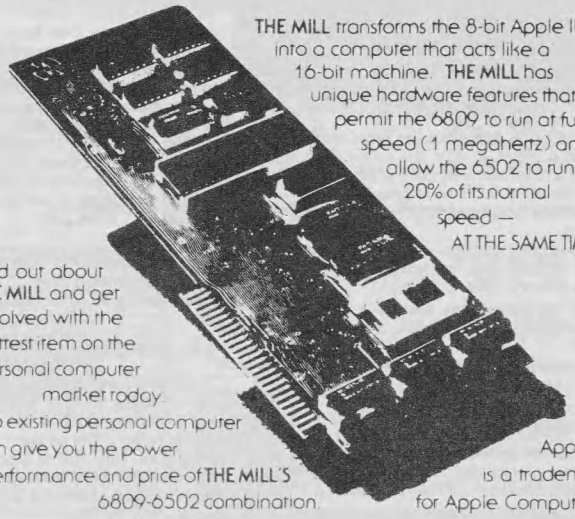
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guage routine that FIG-Forth calls DOCOL (do colon routine?). This routine performs two unique functions: It moves the contents of the IP to the return stack, and it moves the contents of the word pointer into the IP. Then it loads the PC with the address of NEXT.

In the example shown in Fig 15, after the execution of DOCOL the IP will increment through the words in the parameter field of CAMEL. This action is called nesting, and works like a machine-language call instruction. Words can be nested successively many times.

The last word in CAMEL, as in all words consisting of previously defined words, is called SEMIS (for ;S). The purpose of SEMIS is to reverse the effect of DOCOL and get back to the original word. SEMIS is a word in its own right; it is a form of the return routine. SEMIS moves the top of the return stack into the IP, and then loads the PC with the address of NEXT. This action is called unnesting and works like a machine-language return instruction. (See Fig. 16.)

DOCOL and SEMIS are a matched set. This type of word always starts with a DOCOL routine and ends with a SEMIS routine.

Since each type of word requires a different address in the code field, how does Forth know which address to use when a new word is created? The answer is, it doesn't.

In the act of putting the program together, the programmer decides what kind of word it is to be. Then a compiler arranges the word into the prop-

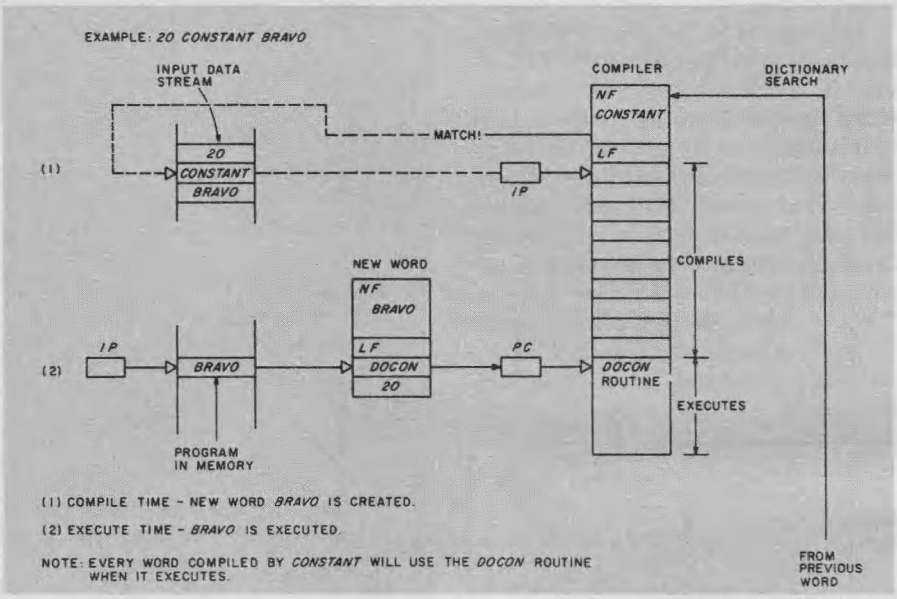
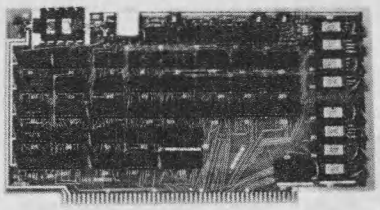


Fig. 17. A compiling word, when executed, creates a new word. The new word, when executed, follows instructions that have been furnished by the compiling word. All the new words go to the same location in memory for their instructions.

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er format. A compiler is simply another Forth word—a program—with specific duties to perform. Forth has a separate compiler for each type of word. A compiler may be called into action by typing its name on the keyboard, as shown in Table 3.

There are other compilers, and you can custom-build your own, but the table lists enough to give you the picture.

A Forth compiler has two main tasks:

(1) During programming: It creates the new word in the dictionary.

= COMPILES
=<BUILDS

(2) During execution: It provides the instructions for the new word to follow.

=EXECUTES
=DOES>

When you type in the name of a word being compiled, it enters an input buffer, where it is part of the input data stream that the computer must sort out (see Fig. 17). Forth does this by searching the dictionary for a matching word. When the word is found, it is executed just like any other word. The result is that a new word is created at the next available location in the dictionary.

Compiling a new word is a relatively long process, with many steps, but it takes place during programming (or loading from disk), when time is not an important factor. Executing the word (a machine-language process) can be very fast.

I'd like to make several last points—in case you haven't noticed,

- NEXT is a machine-language routine
- A machine-language routine always precedes NEXT
- A machine-language routine always follows NEXT

In other words, the high-level language stuff (no matter what the language is) is all a form of bookkeeping, or administration, and directs the activities of the PC, which ultimately has to do all the work.

I am a novice Forth user, and I may have made errors or unwarranted generalizations in this article. Don't be concerned—by the time you're aware of them, you'll already know enough that it won't matter.■

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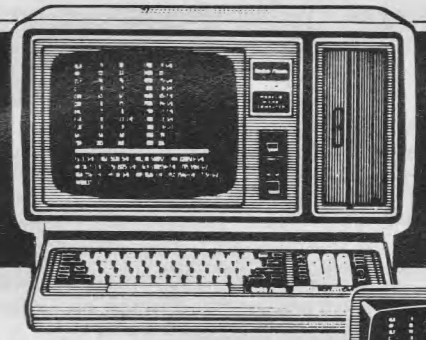
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Using this short Pascal procedure, you can get high-quality printouts of the Apple graphics screen in ten minutes or less.

Pascal Graphics in a Flash

By James R. Florini

The "Hard Copy for Apple Graphics" program published by Thomas D. Brock in the November 1980 issue of *Microcomputing* (p. 100) has been useful in my laboratory; we've used it to prepare drawings for slides, journal figures and grant applications. But as pleased as I am, it has some shortcomings; even in Integer BASIC, it runs rather slowly (35–50 minutes, depending upon the graph being plotted), and my growing experience with Pascal makes me impatient with the tedium of developing advanced graphics programs in BASIC.

A little inspection of pages 90 through 100 of the *Apple Pascal Language Reference Manual* made it obvious that a graphics screen dump to my Diablo printer could be written very easily in Pascal. For one thing, the Pascal graphics screen is organized the way we humans think about graphs, with (0,0) at the lower left and X and Y values increasing as one goes to the right and top of the screen. So I didn't have to invert my thinking, and I didn't have to figure out a complex routine of PEEKs, to read every eighth row of the Apple screen (or whatever). In the Apple Pascal graphics system, you simply use the screenbit function to find whether or not a particular (X, Y) location on the screen is black. The Diablo is then commanded to print a period or a space in that location. For a printer running through a 1200-bits-per-second (bps) connection to the Apple II, this gives a strikingly rapid high-quality printout of the screen; the graph in Fig. 1 took 8 minutes, 47 seconds to complete, and it would be even faster if the boundary lines were omitted.

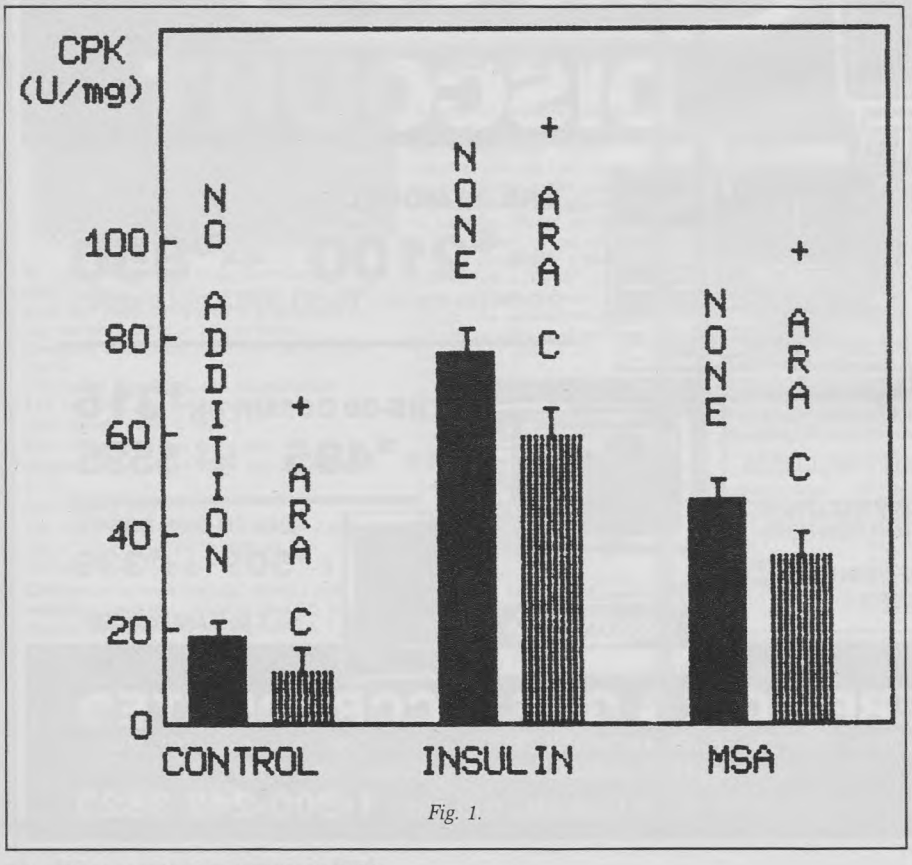


Fig. 1.

The DRAW DIABLO procedure (Listing 1) is simple and requires little comment. The first line changes the screen from black on white (the way we humans like to look at graphs) to white on black (the way the computer thinks about the screenbit function). Then it sets the short incremental printing for the Diablo. In the Xerox Model 1700 I have, this is done by ESC-RS-n for vertical moves and ESC-US-n for horizontal moves. In both cases, n is one greater than the number of increments (1/120 inch for horizontal, 1/48 inch for vertical) the carriage will move after printing a character or spacing. The specific codes that must be transmitted to set small spacing increments differ great-

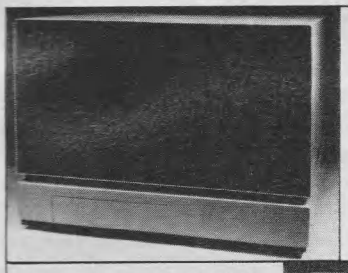
Dr. James R. Florini (7179 Frank Long Rd., Jamesville, NY 13078) is chairman of the Biological Sciences Section of the Gerontological Society of America; he is professor of biochemistry in the biology department at Syracuse University.

ly for different printers, so you will have to consult the manual for your own printer. Of course, not all printers have this small-increment capacity, and unless yours does this program may not be usable. You can use different settings (and perhaps print an * instead of a . for the dots), but I find the 4 by 5 inch graphs produced by these settings quite convenient.

Once the spacing is set, the printer starts at the top of the graph and reads each line of dots in sequence. Unlike BASIC, Pascal runs much faster than the printer can print (even at 1200 bps), so the program first examines each line to see if it contains any black dots; if not (i.e., if NOPRINT remains true), it simply executes a line feed. If so, it then analyzes each point in the line using the screenbit function. Here too, time is saved by not moving the printhead until a dot is found and then using the *:place* Pascal formatting feature to move rapidly to the point at which the dot is to be printed. This saves a lot of time when the line contains only a few points on the left side of the graph. When the graph is complete, the printer is reset to the usual 12 characters and six lines per inch; otherwise the next user might find a decidedly compressed text.■

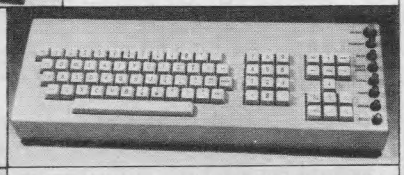
```
PROCEDURE DRAW_DIABLO;
VAR PLACE, X, Y: INTEGER;
    PRINTOUT: TEXT;
    NOPRINT: BOOLEAN;
BEGIN
  FILLSCREEN (REVERSE);                {DELETE IF SCREEN WAS BLACK ON WHITE}
  REWRITE (PRINTOUT, 'PRINTOUT:');
  WRITE (PRINTOUT, CHR(27), CHR(30), CHR(2)); {VERTICAL MOVE = 1/48 IN.}
  WRITE (PRINTOUT, CHR(27), CHR(31), CHR(3)); {HORIZONTAL MOVE = 1/60 IN.}
  WRITELN (PRINTOUT);
  FOR Y:=191 DOWNTO 0 DO                {START AT TOP OF SCREEN}
  BEGIN
    NOPRINT:= TRUE;
    FOR X:=0 TO 279 DO IF (SCREENBIT (X,Y)) THEN NOPRINT:= FALSE;
    IF NOPRINT THEN WRITELN (PRINTOUT) ELSE    {SAVE TIME ON EMPTY LINE}
    BEGIN
      X:=0; PLACE := 0;
      REPEAT
        X:= X+ 1;
        IF NOT SCREENBIT (X,Y) THEN PLACE := PLACE + 1
        ELSE BEGIN
               WRITE (PRINTOUT, '.':PLACE);    {MOVE TO POSITION OF NEXT DOT}
               PLACE := 1
             END;
      UNTIL X = 279;                          {ONE LINE COMPLETED}
      WRITELN (PRINTOUT)                      {START NEXT LINE}
    END;  {IF NOPRINT}
  END;   {FOR Y =}
  WRITE (PRINTOUT, CHR(27), CHR(30), CHR (9));
  WRITE (PRINTOUT, CHR(27), CHR(31), CHR (13)); {RETURN TO REGULAR DIABLO PRINT}
  CLOSE (PRINTOUT)
END; {DRAW_DIABLO}
```

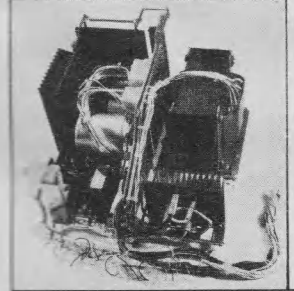
Listing 1. Apple Pascal Graphics program.



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Robert W. Darr

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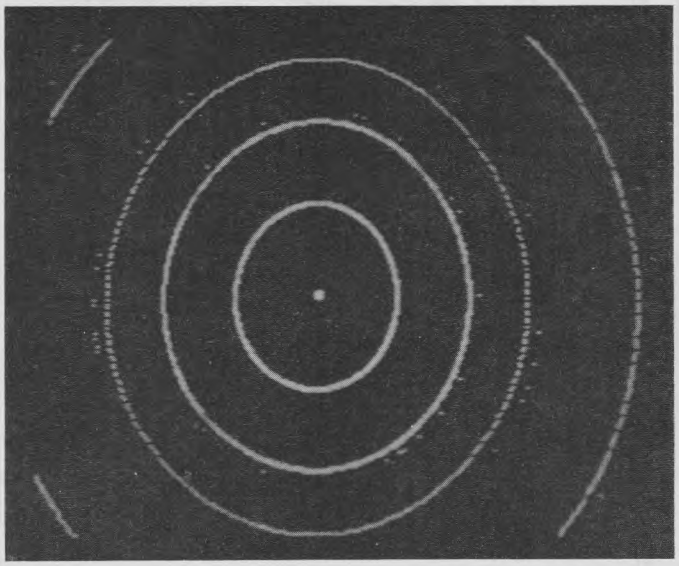
On the view-screen appears the sun, a huge ball of white heat, and circling it the tiny planet Mercury in its orbit of 88 days. Because of your slow time sense, the movement of the planet can be seen. While you are watching, it completes its orbit and you know that 88 days have passed in a few minutes.

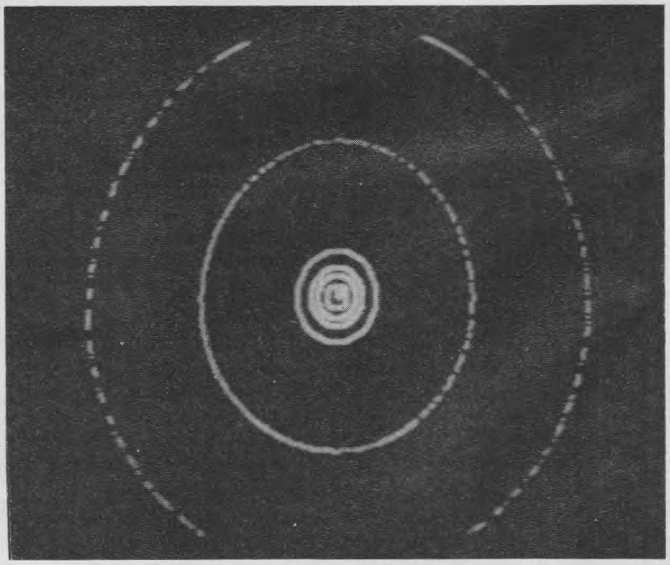
The Second Foundation accelerates, Mercury's orbit shrinks, the planet Venus appears and its motion is also apparent. Mercury is completing its orbit in seconds. The spaceship continues to accelerate and as you draw farther and farther away from the solar system, other planets appear. Then, as the sun dims, the last of the solar bodies comes into view—Pluto, hurtling through the lonely wastes of outer space in its 250-year journey around the sun. The inner planets are now lost in the glare of the sun. In the time it takes Pluto to complete its weary journey, nations will have disappeared, cities will have been built and destroyed. During your month-stay on the earth you made many friends who will have already died as you begin your trip to a distant star. You stare back at the receding solar system.

Fanciful? Of course, but such a journey can be depicted in a planetarium with an orrery.

An *orrery* (named for the Earl of Orrery, Charles Boyle) is a mechanical apparatus for showing the relative

Address correspondence to Robert W. Darr, 9129 Santayana Drive, Fairfax, VA 22031.





Using your game paddles you can vary the orbital speeds of the planets and increase or decrease your distance from the center of the solar system.

positions and motions of the members of the solar system. The Orrery program (see listing) turns the video screen of your Apple into a similar display. Using the game paddles you can vary the orbital speeds of the planets and increase or decrease your distance from the center of the solar system (see photos).

When the program is run the first message on the screen asks you to choose the method of portraying the planets' movements. You can depict planetary orbits with the dots creating more or less circular paths around the sun, or depict planetary motion in a way that makes it easy to see the planets revolve around the sun, and their relative positions. If you press return without entering a 1 or a 2, the program defaults to the first option.

The button on paddle 1 becomes a toggle switch that can change the display from one option to the other. Of course, it has to erase the displayed orbits when changing from the first to the second option. The button on paddle 0 is used to exit the program.

Arrays store the data of the various planets' orbits and the length of their years. Paddle 0 changes the scale of depiction—your distance from the sun. The rate of revolution of the planets is adjusted by paddle 1.

It is perhaps best to start with the first display option and have the paddles set at a minimum. Put the sun in about the middle of the screen by selecting the proper numbers. This will show only the sun and the first planet, Mercury, whose orbit will be traced out as the body moves around the sun. Change the scale by rotating paddle 0 and press the button on paddle 1 until the screen goes to black. Then press it again to return to the orbital display. Experiment until you have the four inner planets on the screen with the sun. You may want to speed up their motion around the primary body. Each time you change the scale, press the button on paddle 1 to clear the screen.

Continue increasing the field of view with paddle 0 until you have the whole solar system in view. By that time you may want paddle 1 at its maximum (Pluto moves rather slowly).

Notice that Pluto's orbit is inside Neptune's. At this time (1981-82), this is actually the case.

Although the true orbits of the planets are ellipses and the screen displays are circles, it will not be noticed at this scale. Of course, some screens depict circles as ellipses anyway due to the settings of the horizontal and vertical controls. You may have a truer built-in depiction.

Depress paddle 1's button to try the second display option. Reset the paddles to their minimum and watch Mercury in its orbit. Increase the scale until you have the four inner planets in view and step up the speed of revolution. It is now possible to see why Venus and Mercury are sometimes in the morning sky and other times in the evening sky. It is also easy to see why the brightness of Venus is so variable, why the inner two planets show phases like our moon and why Venus is brightest when it is a crescent.

If you want to change the scale, change the line that reads

SCALE:=SQR(SCALE)*2E3+5E5;

The rate of revolution is set by the line

TIMEINC:=(1.0*(PADDLE(1)*4+1);

Experiment with these settings. Interesting additions might add a satellite to Earth or four to Jupiter. Another addition might be the ability to show close-ups of the planet systems with the moons revolving about their parent planets. It would be possible to show the various phases of our moon as it revolves about the earth.

To exit from the program, press the button on paddle 0. You will then be given a chance to return to the menu.

The program is written in the 1.1 version of Apple Pascal and uses Chainstuff. If you have the older Pascal, you'll need to delete Chainstuff from the Uses line and the Setchain line at the end of the program in order to use it.■

Program listing. Orrery program in 1.1 version of Apple Pascal.

```
(*$S+*)
PROGRAM ORRERY;
 USES CHAINSTUFF,TRANSCEND,TURTLEGRAPHICS,APPLESTUFF;

CONST
      PI=3.14159;

TYPE
      SOLAR=ARRAY[1..9] OF REAL;

VAR
    SCALE:REAL;
    Q,PAUSE:INTEGER;
    VERT,HORIZ:INTEGER;
    RADIUS,ORBIT:REAL;
    I,J,TIMEINC,THETA,P:SOLAR;
    CH:CHAR;

PROCEDURE PLANDAT; (*INSERTS DATA IN ARRAY*)
  BEGIN
     I[1]:=5.79E7; J[1]:=87.97;
     I[2]:=1.086E8; J[2]:=224.7;
     I[3]:=1.495E8;J[3]:=365.26;
     I[4]:=2.279E8; J[4]:=686.98;
     I[5]:=7.783E8; J[5]:=4.332E3;
```

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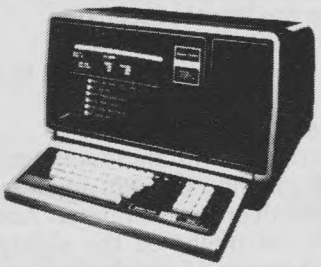
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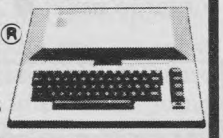
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Listing continued.

```
        I[6]:=14.27E8; J[6]:=1.0776E4;
        I[7]:=28.69E8; J[7]:=2.0665E4;
        I[8]:=44.96E8; J[8]:=6.0191E4;
        I[9]:=5.9E9;   J[9]:=9.073E4;
    END;


PROCEDURE SELECT; (*CHOOSES ORBIT OR MOTION*)
    BEGIN
    WRITELN('1. Orbit Depiction');
    WRITELN('2. Planetary Movement');
    READLN(CH);
  END;


PROCEDURE SUN; (*LOCATES SUN'S POSITION*)
    BEGIN
     WRITELN('INPUT LOCATION OF SUN, HORIZONTAL FIRST');
     READLN(HORIZ,VERT);
    END;

PROCEDURE PLOTSUN; (*PLOTS SUN'S LOCATION*)
VAR DOT:BOOLEAN;
    BEGIN
     DRAWBLOCK(DOT,1,0,0,3,3,HORIZ,VERT,3);
    END;

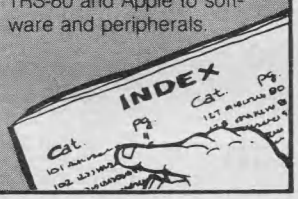
PROCEDURE PLANET; (*LOCATES PLANETS*)
VAR
    X,Y:ARRAY[1..9] OF INTEGER;
    DOT:BOOLEAN;
    BEGIN
     WHILE NOT BUTTON(0) DO BEGIN
       FOR Q:=1 TO 9 DO BEGIN
       ORBIT:=I[Q];
       SCALE:=1.0*PADDLE(0);
       SCALE:=SQR(SCALE)*2E3+5E5; (*SETS SCALE*)
       RADIUS:=ORBIT/SCALE;
        X[Q]:=HORIZ+ROUND(RADIUS*COS(PI/180+P[Q]));
        Y[Q]:=VERT+ROUND(RADIUS*SIN(PI/180+P[Q]));
        IF Q=9 THEN X[Q] :=X[Q]+ROUND(1500E6/SCALE);
        (*FOR PLUTO'S ORBIT
        DRAWBLOCK(DOT,1,0,0,1,1,X[Q],Y[Q],10);
        TIMEINC[Q]:=(1.0*(PADDLE(1)*4+1)); (*SETS MOTION*)
        THETA[Q]:=THETA[Q]+(TIMEINC[Q]*J[3]/J[Q]);
        P[Q]:=PI/180*THETA[Q];
       END;
       FOR PAUSE:=0 TO 1000 DO
     IF BUTTON(1) THEN BEGIN
      IF CH='2' THEN CH:='1'
      ELSE CH:='2'
     END;
     IF (CH='2') THEN BEGIN
       FILLSCREEN(BLACK);
       PLOTSUN;
      END;
    END;
  END;

BEGIN (*MAIN PROGRAM*)
    FOR Q:=1 TO 9 DO BEGIN
    I[Q]:=0;J[Q]:=0;THETA[Q]:=0;P[Q]:=0;
    END;
   SCALE:=0;
   SELECT;
   PLANDAT;
   SUN;
   INITTURTLE;
   PLOTSUN;
   PLANET;
   TEXTMODE;
  WRITELN('DO YOU WANT TO RETURN TO MENU? (Y/N)');
  READLN(CH);
  IF CH='Y' THEN SETCHAIN('#5:ORRERY');
END.
```

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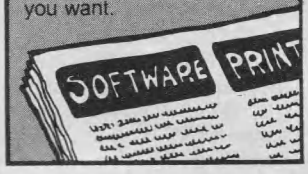
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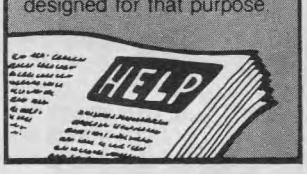
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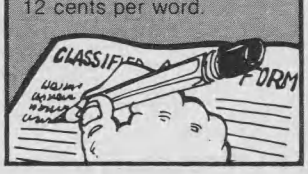
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With these subroutines you will be able to use Heath/Zenith-89's terminal functions in Microsoft FORTRAN programs.

Get Control Of Your Cursor

By Joseph Hesse

I am currently writing several pieces of software in Microsoft FORTRAN for a Heath/Zenith-89 microcomputer with the CP/M operating system.

The terminal portion of the H/Z-89 computer is quite sophisticated and can perform many functions such as graphics, reverse video, auto-line feed on carriage return, and block cursor. These functions are activated by sending one or more ASCII codes to the terminal. For example, if the two ASCII characters ESC and E are transmitted to the terminal, the video screen will be cleared and the cursor will appear in the home position.

It seemed, at first, that I would not be able to use most of these terminal functions in a FORTRAN program, since output in FORTRAN is done with WRITE and FORMAT statements and these did not seem capable of transmitting most non-printing ASCII characters.

As I later realized, I was wrong. The following short FORTRAN subroutine can be easily used to transmit any of the 128 possible ASCII characters:

```
      SUBROUTINE CHR1(Z)
C     ASCII code Z transmitted to terminal.
      INTEGER*1 Z
      WRITE(5,10) Z
10    FORMAT(1X,A1)
      RETURN
      END
```

To use the routine, include it, in the usual way, after the main program and along with any other subprograms you may need.

Suppose, now, that you want to send an ASCII code 07 (bell) in the main program. The FORTRAN statement CALL CHR1(07) will ring the bell in the terminal—CALL CHR1(10) will send a line feed, etc. The only note of caution is that, unavoidably, a carriage return is automatically sent after a CHR1 call. This means that two consecutive CHR1 calls cannot be used, for example, to send the escape sequence ESC, E. Fortunately, this is not a problem.

The following three subprograms allow more than one ASCII code to be transmitted with only a single CALL statement.

Subroutine CHR2(X,Y)

```
C     X,Y, transmitted to terminal, in that
      order.
      INTEGER*1 X,Y
      INTEGER*2 Z
      Z = 256*Y + X
      WRITE(5,10) Z
10    FORMAT(1X,A2)
      RETURN
      END
```

Subroutine CHR3 (U,V,W)

```
C     U,V,W transmitted to terminal, in that
      order.
      INTEGER*1 U,V,W
      INTEGER*4 Z
      Z = 65536*W + 256*V + U
      WRITE(5,10) Z
10    FORMAT(1X,A3)
      RETURN
      END
```

Subroutine CHR4 (U,V,W,X)

```
C     U,V,W,X transmitted to terminal, in
      that order.
      INTEGER*1 U,V,W,X
      INTEGER*4 Z
      Z = 16777216*X + 65536*W + 256*V
      + U
      WRITE(5,10) Z
10    FORMAT(1X,A4)
      RETURN
      END
```

For example, the FORTRAN statement CALL CHR3(27,120,52) sends the ASCII codes 27, 120 and 52 (ESC,x,4) to my H/Z-89 and changes the underline cursor to a flashing block cursor. CHR4, which requires four arguments, can be used to send a three-character escape sequence by inserting an ASCII null at the beginning or end. Thus, CALL CHR4(0,27,121,52) (null,ESC,y,4) changes the block cursor to an underline cursor.

All of the H/Z-89's sophisticated terminal functions can be incorporated in Microsoft FORTRAN programs by using one or more of the CHR subroutines presented in this article. Also, the ideas discussed here should work with other FORTRAN compilers and computers. ■

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```
 10 VISMEM: CLEAR
 20 P=160: Q=100
 30 XP=144: XR=1.5*3.1415927
 40 YP=56: YR=1: ZP=64
 50 XF=XR/XP: YF=YP/YR: ZF=XR/ZP
 60 FOR ZI=-Q TO Q-1
 70 IF ZI<-ZP OR ZI>ZP GOTO 150
 80 ZT=ZI*XP/ZP: ZZ=ZI
 90 XL=INT(.5+SQR(XP*XP-ZT*ZT))
100 FOR XI=-XL TO XL
110 XT=SQR(XI*XI+ZT*ZT)*XF: XX=XI
120 YY=(SIN(XT)+.4*SIN(3*XT))*YF
130 GOSUB 170
140 NEXT XI
150 NEXT ZI
160 STOP
170 X1=XX+ZZ+P
180 Y1=YY-ZZ+Q
190 GMODE 1: MOVE X1,Y1: WRPIX
200 IF Y1=0 GOTO 220
210 GMODE 2: LINE X1,Y1-1,X1,0
220 RETURN
```

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Pascal lets you define your types, thus making your programming easier.

Name That Type

By William L. Roberts

Pascal-based languages include a feature called the type. When I was introduced to Pascal, I was familiar with types as being integer, floating point and so on. But Pascal let me supply my own names for these types, and even define my own.

My first reaction was, "Why would you want to do such a strange thing?" I've since discovered the power of this feature. If you can define your own types, you can write programs more quickly and maintain them more easily.

First, just what is meant by the type of a variable? In a general sense, type describes what values a variable can take. Five types are commonly used in most computer languages: integers, real numbers, characters, strings and arrays, and records.

Numbers

Integers are whole numbers (like 1, 15 or 5,986,256). On most micros, an integer can range between −32,768 and 32,767.

Real numbers are numbers with fractional or decimal parts. They may be single precision (six to eight digits of accuracy), double precision (up to 17 digits) or some other value. The values that a real number can assume are usually in the range consisting of the number from -1×10^{14} to -1×10^{-14}, 0, and from 10^{-14} to 10^{14}.

The interesting point is that there is a range of numbers right around zero that cannot be represented.

The most important point is that a variable can assume a definite number of values. While this number may be very large, it is definitely finite. For example, a real 32-bit number (as used in Microsoft BASIC or in IBM mainframes) can have any one of 4,294,967,296 possible values.

Characters

Variables of the character type are used to hold one character of (usually) ASCII data, such as the letter A or the character +. In most systems, characters are limited to letters (upper- and lowercase), digits (0 through 9), a host of punctuation characters (!@#$%, etc.) and a group of control characters (BEL, STX, etc.). Some characters may not have any defined meanings or may be unique to a particular system.

Strings and Arrays

String and array types are called structured types. They are made up of collections of simpler, basic types. A string consists of a grouping of one or more characters. An array consists of one or more elements of any other type, such as an array of integers or an array of strings.

A string is of variable length. That is, it may be one character long at one point, and later ten characters long. An array, on the other hand, always has a fixed number of elements. If the array is originally declared with ten elements, it will always have ten elements. I'm not going to discuss strings any further in this article, for two reasons. First, Niklaus Wirth did not include strings in the original definition of Pascal. It's not in the ISO or IEEE standards. Second, it is included in many implementations, but each compiler has its own system. So any examples I might give might not be valid on your system.

An array may be an array of arrays. A two-dimensional array (A(3,5), for example) can be thought of as an array of elements each of which is a one-dimensional array. The important point in an array is that every element is of the same type. If A(1) is an integer, A(2) cannot be a string.

Records

Records are used in many business applications. All languages intended for business use, such as COBOL, RPG and PL/1, can define records. More advanced scientific languages, such as ALGOL and Pascal, also have record capability.

The record type is used to define a structure consisting of several different types. Each field may be an item of any other type, including an array or another record. An example of a record is a personnel file. A personnel file can contain such files as shown in Table 1.

Address correspondence to William L. Roberts, 1433 Coddington Road, Brooktondale, NY 14817.

In a powerful language, records and arrays can be mixed in any order. An array can be an array of records, and a record may have a field that is an array (of records if you wish). An example, using the personnel record in Table 1, would be an array of personnel files. There would be many elements, each consisting of a record like the one above.

Boolean Values

The types I've mentioned so far are probably the most commonly used. But Pascal and other modern languages have added more defined types.

Probably the most widely used is the Boolean type. A Boolean variable is one that may have two values, true or false. Booleans are often used to control decisions. If this condition is true then do A; if false do B. Or while P is true, do X.

In many languages, Booleans are the integers 0 and −1. If a test is done, the result is either −1 or 0. The problem is that people are often tempted to do arithmetic with the Boolean values. This produces a meaningless result. What does true plus true mean? With some languages, this will come out to −2. But then, when is −2 or 1 or 3 true?

Many languages say that any integer that is not 0 will be interpreted as true. This is an almost acceptable solution, but not quite. If not true is false and not false is true, this method does not work. Using only the integers 0 and −1 (hexadecimal FFFF) as true and false is okay. Not −1 is 0 and vice versa. All the bits of the integer are reversed. But not +1 is −32767 (FFFE). If 1 is also true, then not 1 is still true (it's not zero). So Boolean values should not be used as integers. They should be represented by their own type, as in Pascal.

Boolean variables are used to store values that are true or false. In the personnel record we're building, we might want to know whether a person is married or not. So we would define a Boolean field for married. It will be set to true if the person is married, false if not.

Field Name	Description
Name	Array of characters
Employee Number	Integer
Hourly Wage	Real Number
Birth Date	Record of three integers, month, day and year
Hours Worked	Array of seven elements, each a real number, one for each day of the week

Table 1. Sample personnel file.

Ordinals

Ordinals are ordered lists of names. The names are constants that are given values in the order in which they are declared. They are used when the values are important only in that they are different and in a specific order.

An example of the use of ordinal types is a job type field that could be added to our personnel record. The job type can be welder, mechanic, plumber, carpenter or foreman. We could say that welder will be represented by 1, mechanic by 2 and so on. But the fact that welder plus 2 equals plumber is purely accidental (and meaningless).

A problem occurs when a programmer has to work on the program and notes that job type is set to 3. He does not know what 3 means, and has to go look it up. Also, the programmer may accidentally assign 53 to a job type. What happens then? If we are using type integer, the program will take this as perfectly reasonable. But a language like Pascal will not allow this error to happen. The values assigned could have just as easily been:

- welder = 5
- mechanic = 12
- plumber = 15
- carpenter = 217
- foreman = 1297

The ordinals (mechanic, plumber, etc.) can be compared to each other. The first one declared is the lowest, the second next and so on. In our example, welder is less than mechanic, mechanic is less than plumber. While ordering doesn't make such sense in this example, it would make sense with a classification such as pay scales (apprentice, journeyman, experienced, master).

Subranges

A subrange is a part of an already-existing range. Subranges are used to limit the allowable values of a variable. For example, our personnel file has a field for birthdate. This is a record made up of three integers. Does setting the month of birth to 29 have any meaning? Of course not. But the program would allow us to do it, and not detect the error.

Finding a bug like this can take a long time. However, if we say that the month field is a subrange of the integers 1–12, the compiler can find and prevent range errors. Then, when we try to assign 29 to the month, we will get an error stop and be able to correct it more quickly.

A subrange can be set up from an ordinal range as well as from integers. For example, we can define a type of weekdays which is equal to Sun, Mon, Tue, Wed, Thur, Fri, Sat. Then we can define a subrange of workdays equal to Monday through Friday. In Pascal notation, this would be written as

```
Workdays = (Mon..Fri)
```

Sets

In mathematics, a set is any collection of items. At times, it is very handy to be able to form sets in programs. In Pascal a set is declared as a set of some basic type. Some examples would be a set of workdays or a set of the integers 1 through 20. The first set can contain any of the values Mon, Tue, Wed, Thur, or Fri, or no value at all. It could not contain Sat. The second could contain any of the integers 1 through 20, or no integers at all. It could not contain 21.

The elements of a set all have something in common. Our personnel record may need a set telling which workdays the employee worked overtime. So we would declare a field.

```
OvertimeDays = Set of Workdays
```

If an employee works overtime on say Monday, we would make Mon a member of the set OvertimeDays. If we wish to know what days the employee worked overtime we check which days are in the set. The following code does this:

```
For Day:=Mon to Fri do with Personnel Record do
  If Day in OvertimeDays then
    CalculateOvertime (HourlyWage, HoursWorked(Day));
```

User Defined Types

The power of languages like Pascal is that the preceding types can be used to declare new types. During my description I have been building a new type called PersonnelRecord. The full description of this record is

```
PersonnelRecord = Record
  Name : Array [1..10] of Char;
  EmployeeNumber : Integer;
  HourlyWage : Real;
  BirthDate : Record
    Month : 1..12;
    Day : 1..31;
    Year : 0..81;
    end;
  HoursWorked : Array [WeekDays] of Real;
  Married : Boolean;
  JobHeld : (Welder, Mechanic, Plumber,
  Carpenter, Foreman);
  JobLevel : (Apprentice, Journeyman, Experi-
  enced, Master);
  OvertimeDays: Set of (Mon..Fri); );
end (PersonnelRecord);10
```

This description lets us declare different variables that assume all the values that a PersonnelRecord may require. I do not have to write out the entire definition whenever I want to use it. The compiler will remember all the details every time.

Even more important, I can use the record without knowing the details. For example, I can write a procedure to calculate the hours worked in the record without knowing anything about it except that there is a field HoursWorked. The record can be passed to various procedures easily. When working with the record, you work not with a collection of fields but with a personnel record.

Techniques for Using Types

Several techniques take advantage of the type feature in Pascal. Of course, the most important is to use the feature.

As I said before, a field in a record may be a record or an array. If you need a field that must be declared as an array or record, you should declare the record as a separate type. Then you can use that type record as a parameter or variable on its own. This allows a lot more freedom of action. In my example of the personnel record, I could declare the BirthDate a little differently. Instead of declaring it as a record, I could declare it as a date type. Then I would declare Date as:

```
Date = Record
    Month : 1..12;
    Day : 1..31;
    Year : 0..81;
  end {Date};
```

Your first reaction to this suggestion may be the same as mine was. "Why would I want to do that? It just means more writing in what seems to be an endless list of declarations." The advantage is that when you want to declare other date variables you already have a working definition. And all the variables will have the same format.

For example, you discover you want to write a procedure to get the birthdate. You could pass the entire record as a parameter to the procedure. But then the procedure would not be transportable to another program. Also, why pass the entire personnel record when only the data is needed. If you pass the entire record to get the birthdate, you cannot use the same procedure to get the date of hire. By declaring the field Date, you can write a procedure

```
Procedure GetDate (Prompt : String, var
RetDate : Date);
```

and call it twice as

```
GetDate ('Enter Birthdate: ', Personnel
Record.Birthdate);
GetDate ('Enter Date of Hire: ',
PersonnelRecord.DateHired);
```

Notice that there is one routine to get one format of a date. We can do this because we have a date data type.

A good general rule derived from the above example is, "Never follow colons or the word 'of' with anything except a type indentifier." This means that you never declare a variable as an array, record, set or ordinal. If you are going to use an array, record, etc. you first declare them in the type section. In records or arrays within the type section, this is also true. Listing 1 shows the Const and Type section for a program that will use the personnel record we have developed.

By correctly using the types in Pascal, you can simplify programming quite a bit. You do not have to worry about the structure of your data every time you access it. Instead, you can concentrate on your problem's solution. The while and if statements are used to structure code. In the same way, proper use of types can be used to structure data. ■

```
Const
     NameSize = 20;
     MonthLimit = 12;
     DayLimit = 31;
     YearLimit = 81;

Type
     NameLength = 1..NameSize;

     NameString = Array [NameLength] of Char;

     MonthRange = 1..MonthLimit;

     DayRange = 1..DayLimit;

     YearRange = 0..YearLimit;

     Date = Record
          Month : MonthRange;
          Day : DayRange;
          Year : YearRange;
     end {Date};

     WeekDay = (Sun, Mon, Tue, Wed, Thur, Fri, Sat);

     WorkWeek = Array [WeekDay] of Real;

     JobType = (Welder, Mechanic, Plumber, Carpenter, Foreman);

     JobRank = (Apprentice, Journeyman, Experienced, Master);

     WorkDays = Mon..Fri;

     OvertimeSet = Set of WorkDays;

     PersonnelRecord = Record
          Name : NameString;
          EmployeeNumber : Integer;
          HourlyWage : Real;
          BirthDate : Date;
          HoursWorked : Workweek;
          Married : Boolean;
          JobHeld : JobType;
          JobLever : JobRank;
          OverTimeDays : OvertimeSet;
          DateHired : Date;
     end {PersonnelRecord};
```

Listing 1.

DISK DRIVES

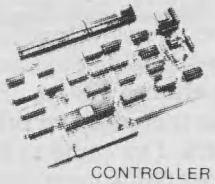
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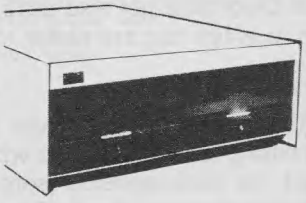
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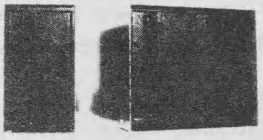
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The test results are in: 68XX systems best Z-80, when it comes to disk operating systems.

68XX Secrets

By Peter A. Stark

A few months ago our school got some new microcomputers which use the Z-80 processor and the CP/M operating system. After reading all the manuals and briefly using this system, I've come to the conclusion that we 68XX users have it better.

There is no doubt that CP/M is a popular operating system, but it seems to offer little that either Flex or SSB DOS does not also have, and often in ways that are easier to use.

Benchmarks

The matter of speed was most interesting. The gentleman who delivered the new systems (some North Star computers using Z-80 processors and some Apple II computers with Z-80 Softcards—a plug-in CPU board that allows the Apple to switch from its 6502 processor to the Z-80A so it can run CP/M) ran a simple BASIC program as a benchmark to show us how fast the new systems were.

I couldn't resist the challenge. Just out of curiosity, I ran the same program (see Listing 1) for him on an SWTP 6800 system using TSC Extended BASIC. The results were:

Apple II (Z-80A at 2 MHz), with Microsoft BASIC—40 seconds.
North Star (Z-80 at 4 MHz), with Microsoft BASIC—20 seconds.
SWTP (6800 at 0.9 MHz), with TSC Extended BASIC—17 seconds.

```
10 FOR I% = 1 TO 100
20 FOR J% = 1 TO 300
30 NEXT J%
40 NEXT I%
```

Listing 1. The two-loop benchmark program.

While this may not exactly be a fair test—Microsoft BASIC is written in 8080 machine language and does not use the full power of the Z-80—the 6800 was also not running at its top speed. Since a 6800 can run at 2 MHz, it would have taken less than eight seconds at that speed.

As a result of that experiment, I began wondering how other 6800 and 6809 software might have done on the same job. Essentially, the program of Listing 1 consists of two simple nested loops. The inner loop repeats itself 30,000 times. Both loop counters were integers (as signified by the percent signs), which, of course, tended to speed up the program by a factor of two or three. I therefore limited my tests to that software which permitted integer arithmetic (see Table 1).

Table 1 is arranged according to run times, with the fastest at the top and the slowest at the bottom. As you might expect, assembly language ranks at the top, followed by compilers and then interpreters. (Since different languages were being compared, the programs had to be rewritten to fit the language system.)

The different languages in Table 1 are compared on characteristics other than just run time. Also listed are the amount of memory required for the program and the time needed for assembly, compilation or loading. These times obviously depend on the disk-operating system, but they do give a rough idea of the time required. Also included in the assembly or compilation time is the printout of the program at 1200 bits per second (bps); subtract about five seconds from each time if you want to calculate the time without a printout. In each case, however, I did not include the time to write or type in the program itself; I started timing when the program was on the disk and ready to run.

The three assemblers listed at the top are all quite popular, and include the TSC 6800 and 6809 assemblers, as well as Percom's 6800 assembler. Between them they cover most users of SWTP, SSB and Percom disk systems. I did not make any attempt to include tape-based assemblers since the time is so dependent on tape speed. In general, all three assemblers require a total of 20 to 30 seconds to assemble the program and then load the resulting machine-language program into memory for execution (though the loading is not done by the assembler itself).

Obviously both 6800 assemblers produced the same machine-language program from the same source program so both programs were 38 bytes long; the 6809 program was three bytes longer because three of the instructions each required an extra byte. See Listings 2 and 3 for the actual 6800 and 6809 programs, respectively. All the listings include all DOS and other commands needed to get from a complete, entered source program to the final run. Run time in all three cases was about one-half second.

Following the assemblers, five compilers are rated. The compilers can be divided into two groups. The A/BASIC (see Listings 4 and 5) and SPL/M compilers (see Listing 6) produced relatively short programs, took

Peter A. Stark, PO Box 209, Mt. Kisco, NY 10549.

from 17 to 30 seconds to compile and had run times of one second. The other compilers, STRUBAL+ and FORTRAN (see Listings 7 and 8), both had very long object programs, took much longer to compile, needed a long link editing process and took seven seconds to run.

Finally, we rated the interpreters. We can see that they had the longest run times but the shortest total times, although they require the most memory. The total times are obviously less since no extra assembly, compilation, editing or loading is required—with an interpreter you simply type RUN, and away it goes. This explains why an interpreted BASIC is the quickest way to run many programs, even though a compiler can produce shorter run times.

Also interesting is the fact that A/BASIC and TSC BASIC interpreted programs are almost as fast as the FORTRAN and STRUBAL+ compiled programs. The A/BASIC interpreter only provides integer capability since it is intended for debugging programs prior to their being compiled with the A/BASIC compiler; hence the interpreter is not very well known or widely used. The TSC BASIC interpreter is much more capable, and hence its run time should be longer.

Run-Time Package

Most compilers don't translate source code directly into straight machine-language code. There are some interesting differences between the 6800 compilers in this area.

Look, for example, at Table 1. SPL/M code is roughly 2½ times as long as the pure assembly language, and its run time is about twice as long; hence most of its code is probably used. A/BASIC's code is about 13 times as long as assembly language, yet it too only takes about twice as long to run as assembly language. Much of that extra code is either not used at all, or else is used only a few times.

FORTRAN and STRUBAL+ are even worse. Their total program code is almost 150 times longer than assembly language, but their run times are only 15 times longer. Again, the conclusion is that a lot of this extra code is either used seldom, or not at all.

This extra code is generally a "run-time package" consisting of subroutines that are called by the main program. 6800 programmers who use assembly language already use a run-time package each time they use INEEE or OUTEEE subroutines in the monitor. The subroutines inside the monitor are, of course, very basic; many compilers use a much more sophisticated set of subroutines, and in some cases some of these subroutines may even *interpret* parts of the source code.

For example, many FORTRAN systems do not translate I/O and FORMAT statements; they carry them along and use a run-time subroutine to interpret and execute them when the program is run.

As another example, Pascal compilers translate into an intermediate language called p-code, which is then interpreted during execution. An extensive run-time package or interpreter is required for even short programs.

Software Dynamics' BASIC, SSB FORTRAN and Hemenway's STRUBAL+ translate into a relocatable program that consists largely of calls to subroutines. A program called a linkage editor then combines this code with the run-time package to make a usable program. The linkage editor can also relocate both the program and the run-time package, so that all the parts of the final package form a single block, rather than being spread around in memory. This is necessary since the writer of the original run-time package had no idea what programs it would be used with and was not able to assign final addresses to each routine. It is the job of the linkage editor to relocate everything so it will work together.

```
+++ASMB PROG PROG.CMD +GS

                              NAM     LOOPTEST
 E07E                 PDATA   EQU     $E07E
 E0E3                 MONITR  EQU     $E0E3
 0100                         ORG     $0100
 0100 CE 01 1A        START   LDX     #MESG1
 0103 BD E0 7E                JSR     PDATA       PRINT 'START'
 0106 C6 64                   LDA B   #100
 0108 CE 01 2C        OLOOP   LDX     #300
 010B 09              ILOOP   DEX                 DECREMENT INNER COUNTER
 010C 26 FD                   BNE     ILOOP       REPEAT UNTIL DONE
 010E 5A                      DEC B               DECREMENT OUTER COUNTER
 010F 26 F7                   BNE     OLOOP       REPEAT UNTIL DONE
 0111 CE 01 21                LDX     #MESG2
 0114 BD E0 7E                JSR     PDATA       PRINT 'DONE'
 0117 7E E0 E3                JMP     MONITR
 011A 53              MESG1   FCC     'START '
 0120 04                      FCB     4
 0121 44              MESG2   FCC     'DONE'
 0125 04                      FCB     4
                              END     START

NO ERROR(S) DETECTED

+++PROG
START DONE
*
```

Listing 2. Assembly-language program using the 6800 TSC assembler.

```
+++ASMB PROG PROG.CMD +GS

                 F80C  PDATA   EQU     $F80C
                 F814  MONITR  EQU     $F814
 0100                          ORG     $0100
 0100 8E   011D        START   LDX     #MESG1
 0103 AD   9F F80C             JSR     [PDATA]     PRINT 'START'
 0107 C6   64                  LDAB    #100
 0109 8E   012C        OLOOP   LDX     #300
 010C 30   1F          ILOOP   DEX                 DECREMENT INNER COUNTER
 010E 26   FC                  BNE     ILOOP       REPEAT UNTIL DONE
 0110 5A                       DECB                DECREMENT OUTER COUNTER
 0111 26   F6                  BNE     OLOOP       REPEAT UNTIL DONE
 0113 8E   0124                LDX     #MESG2
 0116 AD   9F F80C             JSR     [PDATA]     PRINT 'DONE'
 011A 7E   F814                JMP     MONITR
 011D 53 54 41 52      MESG1   FCC     'START '
 0123 04                       FCB     4
 0124 44 4F 4E 45      MESG2   FCC     'DONE'
 0128 04                       FCB     4
                               END     START

0 ERROR(S) DETECTED

+++PROG
START DONE
*
```

Listing 3. Assembly-language program using the TSC 6809 assembler.

Ideally, the linkage editor should be able to pick out of the run-time package only those subroutines actually needed by the program. For example, the benchmark program does not use sines and cosines, so those routines should not be included by the linkage editor when it makes up the complete package. Due to the large size of the complete FORTRAN or STRUBAL+ program, there is a strong suspicion that there are many routines which have been included by the linkage editor but never used; this is substantiated by the fact that the run time is not proportionately longer than that of assembly language.

A/BASIC and SPL/M also use subroutines for various jobs, but these are combined with the translated code directly during compilation—so that no separate linkage editor is needed—and are not as obvious. The code for SPL/M subroutines (actually called procedures) is provided in the manual, and could also be easily changed to fit particular circumstances. (In the sample program in Listing 6, no run-time package was used since I included a PRINT procedure directly in the program. Normally, this and other

Language	Type	Source	CPU	Size bytes	Assy/ Compile	Time in Seconds Link Edit	Load	Run	Total	Notes
Assembly	Assy	TSC	6809	41	29	—	4	<1/2	33	
Assembly	Assy	Percom	6800	38	10	—	10	1/2	20	
Assembly	Assy	TSC	6800	38	25	—	3	1/2	28	
A/BASIC	Comp	Microware	6800	528	17	—	8	1	26	(1)
A/BASIC	Comp	Microware	6800	491	25	—	5	1	31	(2)
SPL/M	Comp	Programma	6800	100	30	—	3	1	34	
FORTRAN	Comp	SSB	6800	5.5K	90	130	9	7	236	
STRUBAL+	Comp	Hemenway	6800	5.5K	140	240	5	7	392	
A/BASIC	Int	Microware	6800	8K	—	—	—	9	9	
ExtBASIC	Int	TSC	6809	19K	—	—	—	10	10	
ExtBASIC	Int	TSC	6800	19K	—	—	—	17	17	
BASIC	Int	Microsoft	Z-80		—	—	—	20	20	(3)
BASIC	Int	Microsoft	Z-80		—	—	—	40	40	(4)

Table 1. Benchmark results on the program in Listing 1. All 6800 timings are at 0.9 MHz clock speed. All 6809 timings are at 1.0 MHz. Sizes include the program and data areas; for compilers they also include the run-time package, and for interpreters they include the interpreter code.

Notes:

(1) Cassette version modified for Percom disk system
(2) Flex version of A/BASIC
(3) Z-80 at 4 MHz on a North Star computer
(4) Z-80 at 2 MHz on an Apple II with a Z-80 Softcard

Abbreviations:

Assy = assembler, Comp = compiler, Int = interpreter

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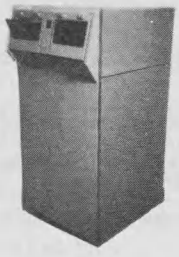


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procedures would be read from a separate source file and included as part of the program. Programma supplies run-time routines for normal console I/O, as well as disk I/O via the Flex disk-operating system.)

This raises an interesting point. Many software producers are secretive about their products, and prefer to distribute their programs in compiled form (less source code) so that customers cannot modify, copy or even fix the programs they have bought. But a program compiled with a compiler requiring an extensive run-time package will not run without it; the run-time routines must be supplied with the software. Several compiler manufacturers charge a royalty for this. Obviously, in this case a compiler that either has no run-time package at all or whose run-time package can be distributed without charge is preferable.

There are two exceptions to this: A/BASIC and SPL/M. SPL/M subroutines are listed in the manual, and some rewriting of these would result in a run-time package (small as it is) that would be entirely your own. On the other hand, Microware advertises that A/BASIC has no run-time package (which is not strictly true), and obviously does not lay any claim on distribution of it.

In the case of Lucidata and Software Dynamics, there is a charge for run-time distribution. This is an item that should be investigated by each potential user.

```
>COMPILE

SOURCE FILE?1200
OBJECT FILE?1210

PASS2
----

PG 001          A/BASIC 1.0C


1000 00010 ORG = $0100 : REM PROGRAM ORIGIN
0100 00020 BASE = $0030 : REM DATA ORIGIN
0100 00030 PRINT "START"
0117 00040 FOR I=1 TO 100
0125 00050 FOR J=1 TO 300
0134 00060 NEXT J
014E 00070 NEXT I
0168 00080 PRINT "DONE"
017E 00110 STOP
0181 00120 END
LST SEC=213
ERRORS  000
VAR LEN $0089
PGM LEN $016E
PGM END $026D
```

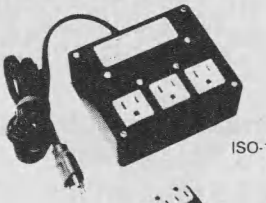
Listing 4. A/BASIC compiled program using the A/BASIC cassette compiler patched for a Percom disk system.

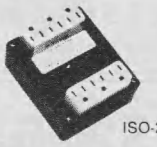
Run Time

As Table 1 shows, there is a wide variation in run times between the various compilers. SPL/M and A/BASIC take roughly twice as long to run as the assembly code; the others take

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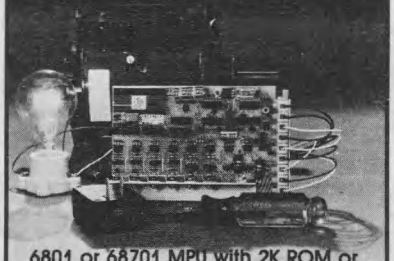
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14 times as long. Of course, part of the reason is that FORTRAN and STRUBAL+ are more powerful, since they allow floating-point arithmetic. Thus they would be expected to take longer.

A/BASIC, SPL/M and STRUBAL+ allow machine- or assembly-language routines to be directly inserted into the source code; parts of the program that are time-dependent or that are repeated very often could be shortened by this means. STRUBAL+ also first compiles into assembly language, and then assembles the result. It is thus possible to edit the assembly-language file to shorten or modify it. In fact, an optimizer is supplied along with STRUBAL+ for shortening or speeding up the assembly code, but in the case of the benchmark it did not make any difference.

Other Comments

As can be seen from Table 1, the compilers are generally faster than the interpreters, though there is not as much difference between the two slow compilers and the fast TSC BASIC as you might expect.

But there is a big difference in total time. Whereas the BASIC interpreters execute as soon as you type RUN, compilers require a complex series of DOS commands to compile, possibly link-edit and load the program. In addition, if the program does not work, then the source code has to be edited before it can be run. With FORTRAN or STRUBAL+, the complete edit-compile-link edit-load-run time might be as long as five or ten minutes. It would be quite time consuming to debug a program. This is aggravated by the fact that the compilers are not very forgiving when you make a mistake, both during compilation and during running. In several cases, when I gave the wrong command during compilation or link editing, the system died and I had to reboot. In some cases, even the disk was erased.

Furthermore, if the source code has an error, the compiled program may go awry. You may then have to reboot the DOS. In all, debugging compiled programs can be very tedious. In FORTRAN and STRUBAL+ especially, debugging can be messy since the object code is so long it is not really feasible to debug the machine-language code.

In this respect, A/BASIC has a very nice feature. In addition to the compiler itself, Microware makes two optional programs that aid in debugging.

One is an assembly-code generator that outputs the assembly code for the translated program (machine code can already be output by the compiler).

Of more interest is the A/BASIC interpreter, which is quite closely compatible with the compiler. It is perfectly feasible to use the interpreter to debug a program, and then compile as the last stage. Though the interpreter and compiler are not exactly compatible, the similarity is close enough.

After using STRUBAL+ and FORTRAN, I was disappointed by the large program size and slow operation—characteristics which, I understand, are also present in the Software Dynamics' BASIC compiler.

I did find, however, that the FORTRAN compiler makes mistakes. On my very first program, I discovered a numeric program that gave the wrong answer; later I found an error in the way the compiler handled strings. On the other hand, I took a very long program that I had run on an IBM 1130 computer years ago, and converted it to run on my 6800 with minimal changes and no problems. Listing 7 shows a FORTRAN program compiled with the SSB FORTRAN compiler.

Flex Patches

The original Flex by Technical Systems Consultants was written for 35-track drives. While most of today's drives allow 40 tracks, there are even 80-track drives available, such as the models 91 and 92 drives from MPI. Table 2 gives the patches to MiniFlex and Flex 2.0 to permit it to be used with either 40- or 80-track drives.

No patches for Flex 9.0 are shown, since there appear to be dozens of different versions of this Flex; moreover, recent versions of Flex 9 allow different numbers of tracks to be specified (especially in versions available from Gimix, which allow formatting any number of tracks).

An article in the May 1980 issue of *'68 Micro' Journal* gave some other Flex patches. To speed up track seek time, it suggested that 1B (hexadecimal) be changed to 18 in locations BEFF and BF5F of Flex 2.0, and DE96 and DEFA of Flex 9.0. However, these addresses are likely to be different in different versions. Moreover, Gimix versions of Flex 9.0 contain the SETUP command for customizing seek time to match the drives being used.

Conditional Assembly

The TSC 6809 assembler has two interesting changes from 6800 assemblers—macros and conditional assembly.

Macros allow new commands to be defined in terms of existing commands. For example, it is possible to define new operation codes and have the assembler use them. It should be possible to define 8080 or 6502 op codes and have the 6809 assembler assemble them.

Conditional assembly gives the assembler the power to skip or repeat parts of the source code, depending on external conditions.

Both of these features require extra code in the assembler which would not be easy to retroactively add to a 6800 assembler. But the conditional assembly feature is a useful one I thought might be nice to have on the 6800 as well.

Basically, the 6809 assembler allows

```
+++ABASIC PROG.TXT PROG.BIN

PAGE 001          MICROWARE A/BASIC COMPILER V2.0D

1000 0010 ORG = $0100 : REM PROGRAM ORIGIN
0100      BASE = $0030 : REM DATA ORIGIN
0100      PRINT "START"
0114      FOR I = 1 TO 100
0122      FOR J = 1 TO 300
0131      NEXT J
014B      NEXT I
0165      PRINT "DONE"
0178      STOP
017B      END

LOAD MAP:

OUT 017F
ERRORS  000
VAR LEN $0089
PGM LEN $0162
PGM END $0261

+++GET PROG
+++JUMP 0100
START
DONE
+++
```

Listing 5. A/BASIC compiled program using the A/BASIC disk-based compiler.

```
+++1.SPLM PROG.TXT PROG.BIN

PROG              SPL/M COMPILER VERSION 1.2

0001  /* LOOP TEST IN SPL/M */
0002
0003  0100H:; /* PROGRAM ORIGIN */
0004  0020H: DECLARE I BYTE, J ADDRESS;
0005         DECLARE MESSG1 DATA ('START ', 4);
0006         DECLARE MESSG2 DATA ('DONE', 4);
0007         DECLARE POINTER ADDRESS;
0008  PRINT:PROCEDURE;
0009        GEN (0DEH, .POINTER);  /* BECOMES LDX POINTER */
0010        CALL 0E07EH;           /* BECOMES JSR $0E07E */
0011  END;
0012
0013  /* MAIN PROGRAM */
0014  POINTER = .MESSG1; CALL PRINT; /* PRINT "START" */
0015  I = 1;
0016  DO WHILE I <= 100;
0017      J = 1;
0018      DO WHILE J <= 300;
0019          J=J+1;
0020      END;
0021      I=I+1;
0022  END;
0023  POINTER = .MESSG2; CALL PRINT; /* PRINT "DONE" */
0024  CALL 0E0E3H;
0025
0026  EOF

****  NO ERRORS

HIGH ADDR USED: 41B5

+++PROG.BIN
START DONE
*
```

Listing 6. SPL/M compiled program.

the user to specify, as part of the DOS command which starts the assembler, up to three extra parameters which are passed to the assembler for its use. These are placed into the command line as in the following example:

ASMB PROG +GS +ONE, TWO, THREE

where the words ONE, TWO and THREE stand for the three parameters.

These three parameters can be any text string. Within the assembly code, they are referred to by the symbols &A, &B and &C, respectively. Each time &A appears in the source code, it is replaced by the first parameter string from the command line. For example, if the source code had a statement which read LDX &A and the first parameter were the word ONE, then the actual source code line would be changed to LDX ONE.

A more interesting use is to permit conditional assembly. Whenever a portion of code is preceded by the statement

IFC &A,test-string

then the following part of the code (up to an ENDIF statement) will only be used if the test-string is equal to the first parameter. These tests can be used with any of the three parameters by using &A, &B or &C.

There is also an IFNC statement which uses the following code only if the test-string does not match the parameter.

This type of conditional assembly, which allows portions of the source code to be skipped based on some parameters, is ideal when you have several slightly different versions of a program which must be tailored to a

```
DOS: FORT 1:PROG.TXT /L=0:PROG.LIS

SSB FORTRAN COMPILER V1.0
    0 ERRORS
DOS: VIEW PROG.LIS
(SSBFC-10-A)  PAGE    1   SSB FORTRAN COMPILER V1.0
*0031     1        WRITE (101, 10)
*003C     2 10     FORMAT ('START ')
*0049     3        DO 30 I=1, 100
*004F     4        DO 20 J=1, 300
*0055     5 20     CONTINUE
*005E     6 30     CONTINUE
*0067     7        WRITE (101, 40)
*0072     8 40     FORMAT ('END ')
*007D     9        STOP
*0080    10        END
    0 ERRORS
DOS: LNK
     SSB LINKER V1.0
LNK: LOAD 1:PROG.T REL
LNK: LIB FORT.LIB
LNK: MALIGN=2
LNK: BOTTOM=0100
LNK: OBJ 1:PROG.ABS
LNK: EXIT
DOS: RUN 1:PROG.ABS
START
END
STOP
```

Listing 7. FORTRAN program compiled with the SSB FORTRAN compiler.

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specific job. Rather than keep different copies of the source code for each version, it is possible to keep just one file but modify it just prior to assembly to produce different machine-language codes.

In my case, I have several different versions of my HUMBUG monitor (see August 1980 issue, p. 119) which differ in only minor respects. For example, some versions have I/O at 8000 (hexadecimal), while other versions have I/O at F800. Rather than keep different source-code versions, I could simply insert a statement such as

PORT1 EQU &C+4

If the third parameter of the call is 8000, then this will become

PORT1 EQU $8000+4

and the assembler will use 8004; if the third parameter is F800, then the assembler will use F804.

Some versions of the program include routines for several different video boards; others do not. I simply allow the second parameter to be either the word TERMINAL, PERCOM or THOMAS. The code then has the statements

IFC &B,PERCOM
  Percom video routines go here
ENDIF
IFC &B,THOMAS
  Thomas video routines go here
ENDIF

In this way, the appropriate video-board routines get inserted for a video-board version, but are omitted for a terminal-based version. Some parts of the two video routines are common, so they are written as

IFNC &B,TERMINAL
  Common routines go here
ENDIF

These routines are omitted for termi-

```
.STRUBAL.BIN

STRUBAL+ COMPILER....VERSION 1.1
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ENTER OPTIONS: .O,L
INPUT FILE: .1:PROG.TXT
OUTPUT FILE: .O:PROG.INT
(C)OMPILE OR (A)SSEMBLE? .C
ENTER PROGRAM NAME: .PROGRM

0001.       INTEGER I,J
0002.       PRINT /,'START',/
0003.       FOR I=1 TO 100
0004.       FOR J=1 TO 300
0005.       NEXT J
0006.       NEXT I
0007.       PRINT /,'DONE',/
0008.       STOP
0009.       END

THERE WERE: 00000 ERRORS
COMMON LENGTH= 00000.
ENTER OPTIONS: .O
INPUT FILE: .O:PROG.INT
OUTPUT FILE: .O:PROG.REL

(C)OMPILE OR (A)SSEMBLE? .A
THERE WERE: 00000 ERRORS
COMMON LENGTH= 00107.
ENTER OPTIONS: .O

.LEDT.BIN

HEMENWAY ASSOCIATES LINKAGE EDITOR
BEGIN PASS ONE
 >.BASE=$2000
 >.LOAD=PROG.REL
 >.LIBRARY=1:RNTM.REL
 >.PASS2
BEGIN PASS TWO
 >.BASE=$2000
 >.BINARY=PROG.BIN
 >.LOAD=PROG.REL
 >.LIBRARY=1:RNTM.REL
 >.CLOSE=BINARY
 >.EXIT
END OF PROCESSING

.LOAD PROG1.BIN
.JUMP $2000

START

DONE
```

Listing 8. STRUBAL+ compilation and link editing.

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nal-based versions, but are included on both video-board versions.

This technique makes program maintenance much easier, especially when you have five or ten slightly different versions. Whenever a change or update is required, you need only change one source code, not five or ten different versions.

The only catch is that the TSC 6809 assembler allows this, while 6800 assemblers do not. So we write a BASIC preprocessor program that reads the original conditional assembly code and converts it into a specific version which can then be assembled by the 6800 assembler.

Listing 9 shows the resulting program written in Percom Super BASIC. The only special statement is the LINPUT statement, which allows the program to read an entire line of text from a disk file, including commas and quotes. In other BASICs it may be necessary to rig up a substitute to read a line despite possible commas in the text, which would normally break up the text into separate strings.

One acceptable substitute would be to use

READ A$,B$

IF B$<>" " THEN A$=A$+", "+B$

which reads a line as two strings. If there was no comma in the text, then B$ will be empty and nothing will be done in the second line. But if there was a comma, then the rest of the line after the comma will be in the B$ string and the second line will put the two strings back together with a comma and space separating them. (If there is a possibility of more than one comma per line, then a third string (C$) should be added.)

The BASIC program in Listing 9 is quite straightforward. At the beginning, it asks for the input and output file names and the three parameters. It then reads each line from the input file and searches for IF, ENDIF, &A, &B or &C. If these are not encoun-

Listing 9. BASIC conditional assembly preprocessor.

```
0010 REM INITIALIZE AND GET DATA

0020 LINE= 0
0030 STRING= 72
0040 INPUT "INPUT FILE NAME", F$
0050 INPUT "OUTPUT FILE NAME", O$
0060 DIM P$(3)
0070 FOR I=1 TO 3
0080     PRINT "PARAMETER "; I; " ";          : REM GET PARAMETERS
0090     INPUT P$(I)
0100 NEXT I
0110 P=1                                      : REM INIT PRINT FLAG

0120 REM OPEN FILES AND GET READY

0130 OPEN #12, O$
0140 OPEN #11, F$

0150 REM MAIN DATA READ LOOP

0160 LINPUT #11, A$                           : REM ADD E-O-F TEST TO FIT
0170 IF MID$(A$,2,5)="ENDIF" THEN P=1 : GOTO 160

0180 REM CHECK FOR AN IF AND PROCESS IF FOUND

0190 IF MID$(A$,2,2)="IF" GOTO 340
```

(Continued on page 98)

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tered, then the line is simply sent to the output file.

When IF is found, the program checks the parameter and sets a flag to indicate whether the following code should be included or not. If it is not IF, then the program substitutes the parameter instead of the & code.

Although this program is aimed at a specific use, the idea of using a BASIC program as a preprocessor for other programs is quite useful. For example, it is possible to write a BASIC preprocessor which will process other BASIC programs to allow what the standard BASIC interpreter does not permit—long variable names or line labels instead of line numbers. That part is left up to you.■

DOS	Routine	Address	35 Track	40 Track	80 Track
MiniFlex	NEWDISK	027F	23	28	50
		02C7	23	29	50
		02FD	0264	02BE	058E
		0307	22	27	4F
		0341	23	28	50
	FLEX.SYS	7A75	22	27	4F
		7A2E	843F	843F	847F
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		A245	23	28	50
		A286	0154	0186	0316
		A2EA	23	28	50
		A3BF	22	27	4F
		A28B	22	27	4F

Table 2. Flex patches for 40- and 80-track disks. The hexadecimal addresses shown may be slightly different versions of Flex.

Compilers

There are a number of 6800 compilers available for SS-50 systems.

BASIC from Software Dynamics, 2111 W. Crescent, Anaheim, CA 92801.

A/BASIC from Microware Systems Corporation, PO Box 4865, Des Moines, IA 50304.

FORTRAN from Smoke Signal Broadcasting, 31336 Via Colinas, Westlake Village, CA 91361.

SPL-M from Programma Associates, 3400 Wilshire Blvd., Los Angeles, CA 90010.

STRUBAL+ (a Structured BASIC Language) by Hemenway Associates, 101 Tremont St., Suite 208, Boston, MA 02108.

UCSD Pascal from Tallgrass Technologies Corp., 7623 W. 86th St., Overland Park, KS 66212.

P-6800 Pascal from Lucidata Ltd., PO Box 128, Cambridge CB2 5EZ, England.

M-Pascal from Phillips Fineware, 876 Plante Drive, Ottawa, Ontario K1V 9E2, Canada.

Dynasoft Pascal from Dynasoft Systems Ltd., PO Box 51, Windsor Jct., Nova Scotia, Canada B0N 2V0.

There are also several 6809 compilers but I have not had the chance to try them.

Almost all of the available 6800 compilers require disk systems; only A/BASIC is available in a cassette version (though the ads for M-Pascal state that cassette operation is possible with some modifications, and I suspect very little work would be required to adapt SPL/M to cassette use).

Disk Systems

A/BASIC—SWTP and SSB, five-inch. Percom has published a patch to adapt the cassette A/BASIC to Percom disks, and the June 1981 installment of this series (p. 136) shows how to use the cassette version on 6800 systems using monitors other than Microware's RT-68 monitor.

SSB FORTRAN—SSB five-inch disk.

SPL/M—SWTP disk with Flex 2.0. Source code for I/O routines is provided, and conversion to MiniFlex is a cinch; conversion to SSB disk or cassette should be fairly straightforward.

STRUBAL—SSB, SWTP or Percom disks.

USCD Pascal—SWTP five- or eight-inch disks.

P-6800 Pascal—SWTP (MiniFlex or Flex 2.0).

M-Pascal—SWTP (MiniFlex).

However, since Percom's Softran translator programs allow MiniFlex, Flex 2.0 or SSB DOS to run on the Percom system, all of these could run on that as well.

Language Type

Obviously, the language used will play an important part in choice of compiler.

If you need FORTRAN, then there is only one choice. Likewise, if you need compatibility with UCSD Pascal on other computers, there is only one choice.

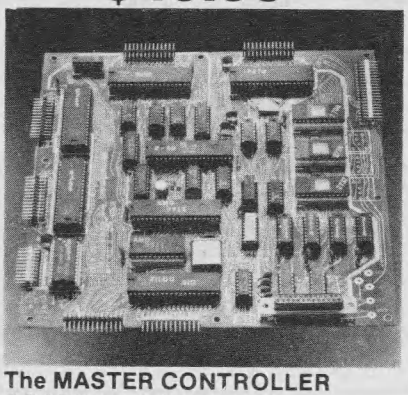
Of the BASICs, Software Dynamics has floating-point math (which means that noninteger numbers are allowed), while A/BASIC only uses integers (but faster). Likewise, SPL/M and M-Pascal are integer-only; all the rest provide floating-point.

SPL/M is substantially different from the rest. Not nearly as powerful as BASIC or FORTRAN, it can do things the others cannot. For instance, SPL/M is the only language that can be used to write subroutines that can be called by machine-language programs. Hence SPL/M is fine for writing systems software. You could write a disk-operating system or monitor in SPL/M quite easily. (On the other hand, if you wanted to write a payroll program, SPL/M would be a bad choice.)

Though SPL/M is somewhat inefficient as compared with assembly language—program size is about 2½ times the assembly code, and the run time is about twice as long—that trade-off may still be worthwhile if it makes programming easier. Thus SPL/M is limited in its appeal, but excellent within its narrow niche.

As Listing 6 shows, SLP/M is a structured language with procedures, DO-WHILE statements and variable declarations. STRUBAL+ also has some of the structured conventions which make Pascal so dear to many, but it also has some of the more traditional features of BASIC.■ *P. Stark*

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(Continued from page 96)

```
0200 REM SEARCH FOR AN & AND REPLACE IF FOUND

0210 I = 1
0220 IF MID$(A$,I,1)<>"&" GOTO 280
0230 B$=MID$(A$,I+1,1)                          : REM CHARACTER AFTER &
0240 IF B$<"A" GOTO 280                         : REM SKIP IF NOT A-C
0250 IF B$>"C" GOTO 280
0260 B$=P$(ASC(B$)-ASC("A")+1)                  : REM PICK UP PARAMETER
0270 A$=LEFT$(A$,I-1) + B$ + RIGHT$(A$,LEN(A$)-I-1) : REM SUBSTITUTE
0280 I = I + 1
0290 IF I<LEN(A$) GOTO 220

0300 REM PRINT AND OUTPUT TO FILE

0310 IF P=1 THEN PRINT A$ : PRINT #12, A$
0320 GOTO 160

0330 REM PROCESS IFC AND IFNC

0340 IF MID$(A$,2,4)="IFC " THEN C=1 : N=6 : GOTO 380
0350 IF MID$(A$,2,5)="IFNC " THEN C=0 : N=7 : GOTO 380
0360 PRINT CHR$(7); "IF IGNORED", A$            : REM IF ERROR
0370 GOTO 160
0380 L=LEN(A$)
0390 L$=""

0400 REM SEARCH FOR COMMA AFTER IF

0410 FOR I=N TO L
0420     IF MID$(A$,I,1)="," GOTO 470
0430     L$=L$+MID$(A$,I,1)                     : REM GET TEXT BEFORE COMMA
0440 NEXT I
0450 STOP                                       : REM NO COMMA FOUND

0460 REM COMMA HAS BEEN FOUND AFTER IF

0470 N=I+1
0480 IF N>L THEN STOP                           : REM COMMA WAS AT END
0490 R$=RIGHT$(A$,L-N+1)                        : REM TEXT AFTER COMMA
0500 IF LEFT$(L$,1)="&" GOTO 520
0510 T$=L$ : L$=R$ : R$=T$                      : REM SWITCH IF NECESSARY
0520 I=ASC(RIGHT$(L$,1)) - ASC("A") + 1
0530 IF I>0 THEN IF I<4 GOTO 550
0540 PRINT "PARAMETER ERROR -- "; A$ : STOP
0550 C$=P$(I)                                   : REM GET PARAMETER

0560 REM NOW DECIDE WHETHER PARAMETERS MATCH, AND
0570 REM WHETHER TO SET PRINT FLAG OR NOT

0580 IF C=1 THEN IF C$=R$ THEN P=1 : GOTO 610
0590 IF C=0 THEN IF C$<>R$ THEN P=1 : GOTO 610
0600 P=0
0610 GOTO 160                                   : REM AND THEN REPEAT
```

DOS Update

If you look at Listing 8, you will see that the STRUBAL+ compiler was run under CP/68. This compiler is available for all the popular 6800 operating systems, and my choice of CP/68 was strictly to gain some familiarity with it.

CP/68 is an interesting disk-operating system that has some similarities to other systems, especially in its use of the PIP routine. In some ways I thought it was similar to CP/M as well as some earlier Digital Equipment Corp. minicomputer operating systems.

CP/68 and STRUBAL+ are especially interesting in one respect—they are both available with full source code. Though the version given in the book was slightly different from the actual code, it was close enough to allow modifications to fit my system.

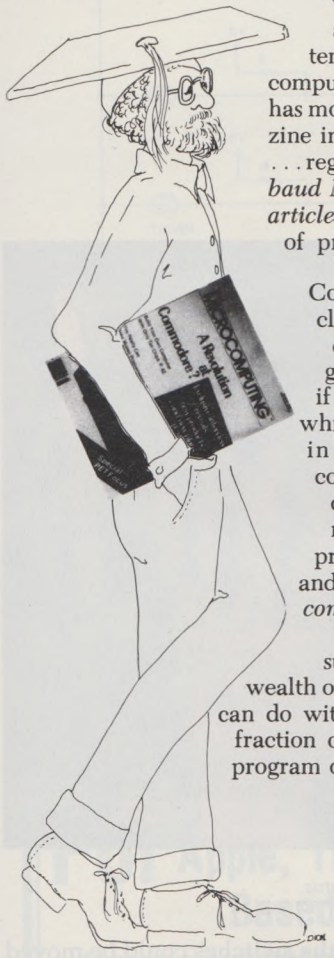
In other respects, however, I found the manuals hard to read. Although these are quite thick and contain a lot of information, the organization makes it hard to find things. In several areas I had to make rather educated guesses, and try a few commands before I found the right sequence. Several times I accidentally erased files or clobbered disks because of the wrong sequence of commands. But these are problems which obviously would go away with some familiarity.

The major problem with CP/68 is its lack of support by other vendors. Although Hemenway offers a text editor, assembler, linkage editor and compiler, they do not offer a plain BASIC interpreter, disassembler or other useful systems and application software; nor does anyone else. In that sense, the choice of a more popular disk-operating system would probably be better. ■ *P. Stark*

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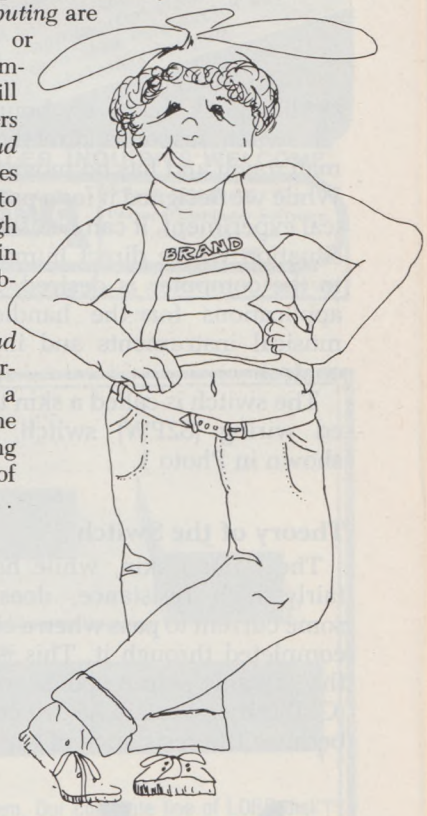


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Photo 1. Finger-tapping apparatus.

Theory of the Switch

The human skin, while having a fairly high resistance, does allow some current to pass when a circuit is completed through it. This is called the galvanic skin response, or GSR. (GSR is measured in lie detector tests because the resistance of the skin is lessened when a person is under stress.)

The S2PW switch uses this principle by comparing the voltage of a completed circuit through the fingertip with a given standard voltage. If the voltage through the circuit is greater, then the finger is present. If not, then the finger has been lifted.

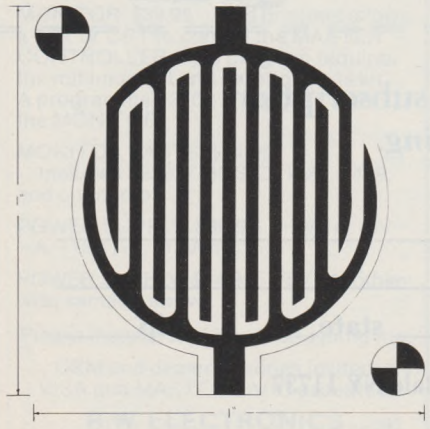


Fig. 1. Printed circuit to detect finger contact (magnified 2×).

Building the Switch

The finger completes the circuit when it comes in contact with a printed circuit (illustrated in Fig. 1). The finger-tapping apparatus built for the psychological experiment had eight of the switches glued to a Velcro fastener so the switches could be moved to allow for different-sized hands. You may need to silver- or nickel-plate the contacts, although the copper plating has given us no trouble up to this point.

The voltage comparison is performed in the circuit diagrammed in Fig. 2. The LM339N chip allows four simultaneous comparisons; thus two

Address correspondence to David W. Stockburger and Allen Penn, Psychology Department, Southwest Missouri State University, Springfield, MO 65802.

circuits are needed for eight fingers. Experimentation with the circuit showed that resistors R1 through R4 could range between 252 kilohms to 10 megohms. The higher the value of these resistors, the greater the sensitivity of the switches. A variable resistor would allow for individual differences, such as sweaty palms or the calloused fingertips of a guitar player.

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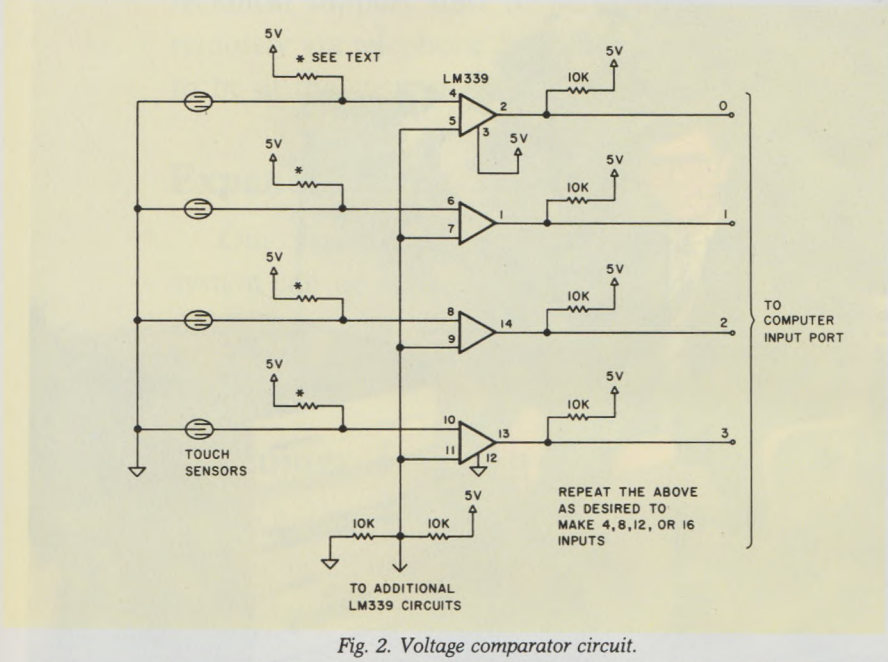


Fig. 2. Voltage comparator circuit.

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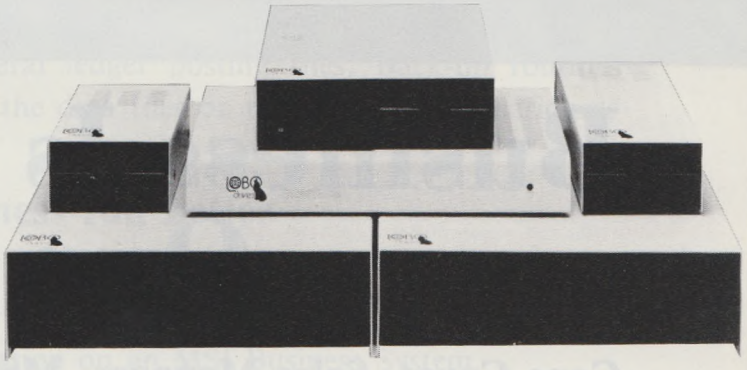
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A Fully Graphic Apple

By Rolf A. Deininger

If you need a graphics station but don't have a lot of money, consider an Apple microcomputer with a Hiplot plotter. For about $4000, you can have a system that will let you construct, scale and plot graphs in a variety of colors for both research and teaching. The cost is about one quarter that of a comparable system using a Tektronix graphics terminal.

The system we use includes an Apple II with 48K bytes of memory, floppy disk and monitor, a communications card, modem, the Hiplot and a TEKSIM chip. It can be used in two modes—as a simple graphics terminal and as a remote plotting station for a host computer.

In the first mode, the TEKSIM (Tektronix Simulator) turns the Apple into a Tektronix 4010 terminal. The only real difference is in the resolutions—1000×700 pixels for the



A full graphics station consisting of an Apple microcomputer and the Hiplot printer.

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TEKSIM chip and software, ABW Corp., 1929 Plymouth, Ann Arbor, MI 48105	500
Cables, pens	100
Total	**$4100**

A list of parts and prices.

Dr. Rolf A. Deininger is a professor of environmental health at the University of Michigan's School of Public Health in Ann Arbor, MI 48109.

A simple command lets you start plotting while on-line to the host computer.

Tektronix vs 280 x 192 for the Apple. Thus, in a large graph, some of the details are not as clearly visible. But since the paddles give you a full blow-up feature, you can enlarge any part of the graph to look for details. Once you've constructed a graph, you can send it to a central plotting system for output.

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Fig. 1 shows a graph constructed on the University of Michigan computer system and plotted off-line on the Hiplot. The data is from a water-quality monitoring station on the Ohio River and shows the concentration of suspended and total solids in the river. Fig. 2 shows another graph on some of the ongoing research on the relationship between drinking water and health. The rectal and colon cancer rates for white males are plotted versus the organics content in the drinking water. Again, the construction of the graph and the lettering were done on the host computer Amdahl 470/V8), and the graph was plotted off-line.■

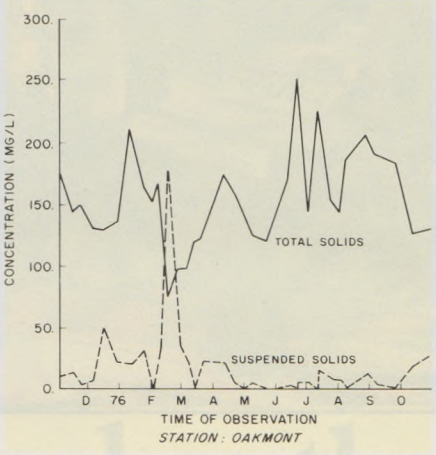


Fig. 1. Sample graph produced by the Apple II and Hiplot.

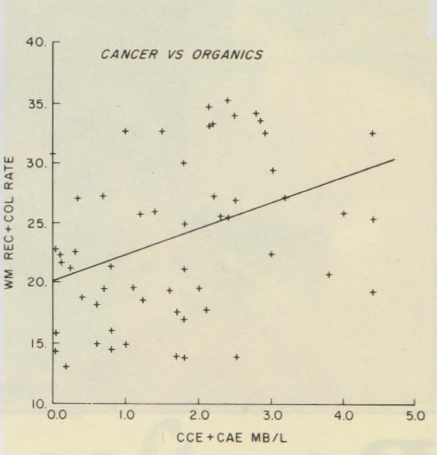


Fig. 2. Graph used in the study of drinking water and health.

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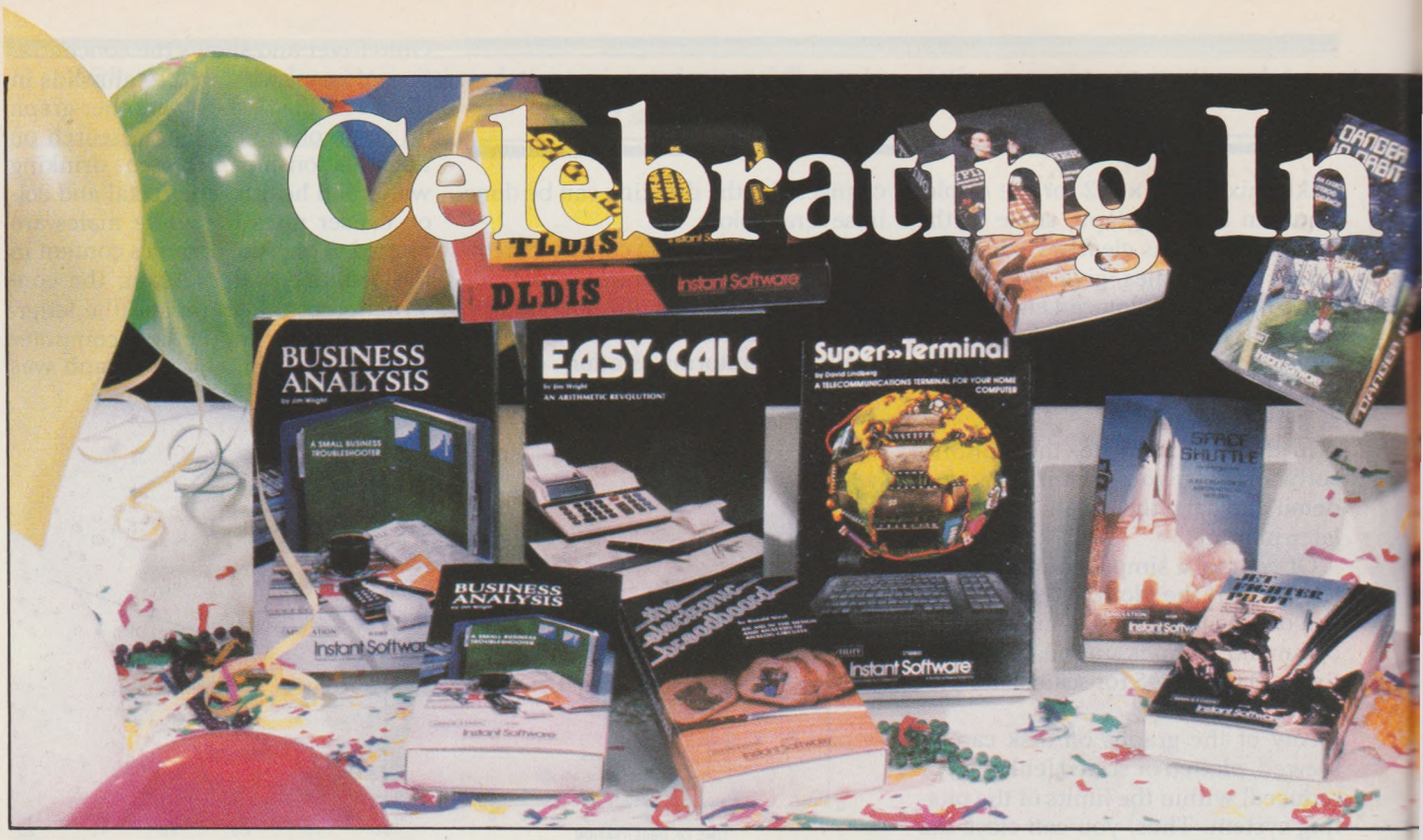
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Sherlock Holmes would have loved this game for the Apple and TRS-80.

Color Code Combo

By R. Daniel Bishop

"Elementary, my dear Watson! If only two colors are correct when you have guessed 'red-red-blue-green,' and two colors are correct when you have guessed 'blue-blue-green-red,' then you cannot have two blues or two reds, so you also cannot have both blue and red together. This means that you must have three greens, and since you have no correctly placed colors in your first guess, the three greens must occupy the first three squares. Furthermore, with only one correctly placed color in your second guess, it must be that the fourth square is blue, and your code is 'green-green-green-blue.' "

My sincere apologies to Conan Doyle for suggesting that Sherlock Holmes, the super hero of deductive reasoning, would have demeaned himself with such a trivial problem. But it is true that much of the scientific foundation of modern technology derives from effective and sometimes brilliant deductive reasoning. Learning to correctly deduce answers to seemingly impossible questions is a skill most often acquired through practice. But setting up problems to test and fortify this skill can be a formidable task.

Mastermind, a game recently patented and marketed by Invicta Plastics Ltd. of Leicester, England, provides the opportunity for one player to exercise his powers of deduction to break a code offered by his opponent. The code consists of a sequence of four colored pegs. Each peg can be any of six available colors, and the code sequence is, of course, shielded from the player trying to break the code.

The game can be tailored to present a challenge to all players.

The code breaker establishes a guess by arranging four colored pegs in a row. He asks his opponent to evaluate the guess, and is then told how many of the pegs that he has chosen are the correct color, and how many of these pegs are located in the correct positions of the board (thereby corresponding exactly, color and position, to a peg in the code). Although the code breaker isn't told precisely which pegs are the correct color or correctly placed, it becomes clear after several guesses and successive evaluations that certain deductions can be made regarding the code.

Although this game provides some variation on the above procedure, it can easily frustrate younger children who have had little experience in deductive reasoning. On the other hand, for many adults the game is not very challenging. And two people must be available to play.

The microcomputer can easily solve these problems. By randomly selecting the colors and their arrangement for the player, the computer makes a second player unnecessary. It allows the player to choose the number of colors to be used (3-8), the number of pegs (size of tableau) to be used in the code (again 3-8) and the number of guesses permitted (4-12); thus the game can be tailored to present a challenge to all players, from the preschooler to the adult mastermind.

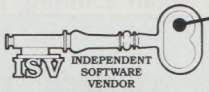
This article provides listings for the TRS-80 (Listing 1) and Apple (Listing 2) versions of Color Code Combo. The three parameter options are available at the beginning of each game. And unlike human players, the

Address correspondence to Dr. R. Daniel Bishop, Custom Comp, PO Box 429, Buena Vista, CO 81211.

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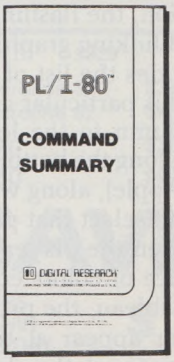
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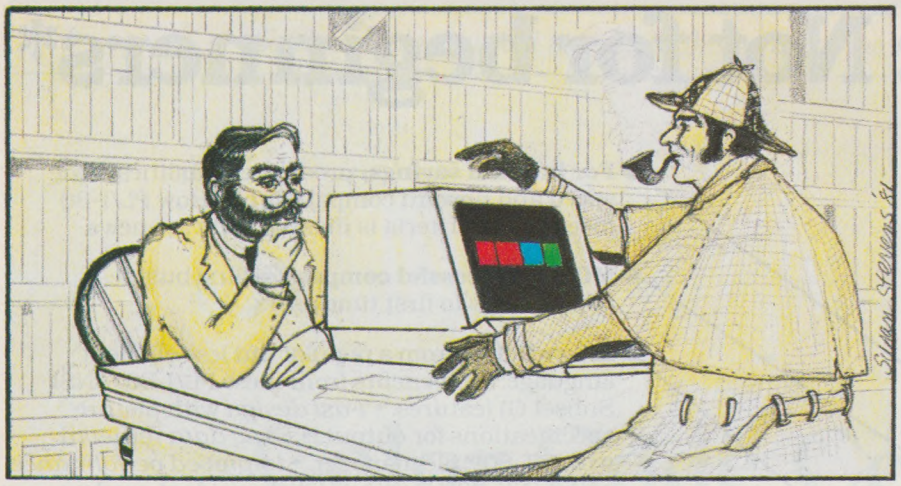
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computer doesn't make mistakes when it evaluates a guess.

Playing the Game

At the beginning of each game the player selects the number of colors to be used, the size of the tableau and the number of guesses to be allowed, keeping his responses within the limits shown above and displayed on the screen. The Apple version provides one more option—it can be run in color, using page 1 of low-resolution graphics, or in black-and-white, using an alphabetic character to represent a given color (R for red, etc). Response to this question is made by pressing the letters C or A.

The screen display is then presented with the flashing cursor marking the position of play. (In the color version, the flashing cursor is actually a blinking graphics block.) A table provides the list of acceptable colors for this particular game (displayed in a column to the left on the TRS-80 and along the bottom of the screen for the Apple), along with the alphabetic key to select that particular color.

When the player has guessed a sequence of colors equal to the size of the tableau, the prompt and flashing cursor appear at the bottom of the screen to ask the player to press X for corrections or E to end his turn. Pressing the X key erases the guess just made and returns the cursor to the appropriate row, allowing the player to revise his previous guess. Pressing the E key causes the computer to evaluate the guess just made and respond with the number of correctly guessed colors and correctly placed colors.

Using the example presented in the opening paragraph (and illustrated in Fig. 1), the evaluations would have been 2 and 0 for the first guess, and 2 and 1 for the second guess. If a third guess had been made, green-red-blue-green, the evaluation would have been 3 for correct colors (two greens and a blue) and 1 for correct placement (the first green). The player can now make another guess, if he hasn't reached the limit selected at the start of the game.

If the correct code is not guessed in the allotted number of tries, the game ends with the computer displaying the correct code and an appropriate comment.

The Apple version lets the player switch back and forth during the game between the color-graphics presentation of the board and an alphabetic presentation. This can be done before each evaluation by pressing the S key to switch modes.

The interpretation of the evaluations while in the color-graphics mode is slightly different. Correctly chosen colors are represented in the evaluation column as a lighted block on the same row as the guess being evaluated. Each white block represents a correctly chosen color that is *not* properly placed. Each red block represents a perfect match with the code, both in color and in placement. Thus two red blocks and three white blocks represent five correct colors, two of which are correctly placed. This would correspond to a 5 for correct colors and a 2 for correct placement in the alphabetic display.

The Programs

I have adjusted both program listings to make their respective line numbers correspond as closely as possible to each other. Thus, you can readily compare a part of the BASIC instruction set used by the two sys-

CHOICES:		CORRECT COLORS	CORRECT PLACEMENT
R RED	#1 R R B G	2	0
B BLUE	#2 B B G R	2	1
G GREEN	#3 G R B G	3	1
	#4		
	#5		
	#6		
	#7		
	#8		

PRESS X FOR CORRECTION;
PRESS E TO END TURN.

Fig. 1. A simulated TRS-80 display of Color Code Combo. Example of guesses and corresponding evaluations used in the game.

	TRS-80	Apple
Simple timing delay loop:	10	10
Flashing cursor:	25	25
Alphabetic display formatting:	65	600
Color-graphics display formatting:	--	400
Options listing:	90	90
Guess evaluation:	260	260
Concluding responses:	325	325
Color correlation with alphabet:	--	500
Color display of evaluation chart:	--	520
Conversion from color-graphics to alphabetic display:	--	700

Table 1. List of subroutines.

A$	Keyboard response character.
A	Numeric value of A$.
C	The number chosen for the number of colors in the game.
T	The size of the tableau.
G	The number of guesses.
S	* Whether alphabetic (S=1) or color-graphics (S=2) mode.
B$	The character used to alternate with * for the flashing cursor (TRS-80).
F1	A flag in the flashing cursor subroutine indicating with a 1 that a keyboard response has been made.
CR$	The cursor character used by the TRS-80 program.
CR	The cursor position.
R$	The randomly generated computer code.
CC	The number of correctly chosen colors.
CP	The number of correctly placed colors.
RT$	A temporary variable to hold the value of R$.
I, J, K and L	Loop variables.

(An asterisk (*) denotes a variable used only with the Apple listing.)

Table 2. List of variables.

tems. Number correspondence also simplifies the documentation which follows.

The REMark statements have been included to clarify the listings. They are not necessary for the operation of the programs and can be omitted if you wish.

All program branches are to line numbers containing operational statements. If you use the Apple version only in the alphabetic mode (for black-and-white-only applications), much of the Apple listing can be omitted; the color-graphics mode is handled in distinct subroutines.

Because of the need to store intermediate guesses in the Apple program in order to allow switching from alphabetic to color-graphics mode and back, the Apple version requires dimensioning three variables (line 5) to hold the color sequence and evaluation results of each guess. Furthermore, although the Apple automatically provides for a flashing cursor in the alphabetic mode, in the color-graphics mode it is necessary to program it. Thus lines 16–56 in the Apple program provide the flashing color-graphics block, while lines 16–56 in the TRS-80 program provide

ZB, ZC	Alternating colors of the flashing graphics block.
X$(i)	Stores the string corresponding to the *i'th* guess.
CC(i)	Stores the number of correct colors for *i'th* guess.
CP(i)	Stores the number of correctly placed colors for the *i'th* guess.
H,V	Horizontal and vertical tab positions for the cursor.
X,Y	Horizontal and vertical vectors for positioning a graphics block with the PLOT instruction.

Table 3. List of additional variables used in the Apple version.

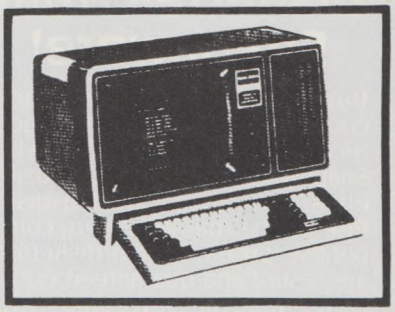
Listing 1. TRS-80 listing.

```
 1 REM    COLOR     DEV. FOR TRS-80 BY D. BISHOP
 2 REM    CODE          1981  CUSTOM COMP
 3 REM    COMBO     BOX 125   BRANSON, MO 65616
 4 REM
 5 GOTO100
 9 REM
10 REM  **  DELAY LOOP SUBROUTINE  **
15 FORI=1TO999:NEXT:RETURN
16 REM
20 REM  **  FLASHING CURSOR SUBROUTINE  **
21 REM
25 IF CR$=B$ THEN CR$="*" ELSE CR$=B$
30 PRINT@CR,CR$;
35 FOR I=1 TO 15
40   A$="":A$=INKEY$
45   IF A$<>"" THEN IF   ASC(A$)<>13 THEN A=VAL(A$):I=15:F1=1
50 NEXTI
55 IF F1<>1 THEN 25   ELSE F1=0:RETURN
56 REM
60 REM  **  DISPLAY FORMATTING SUBROUTINE **
61 REM
```

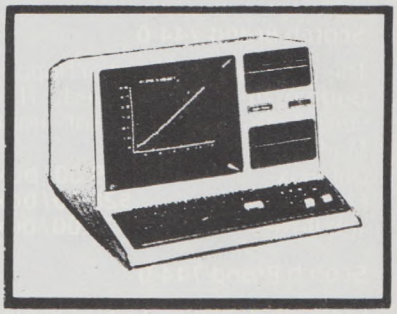
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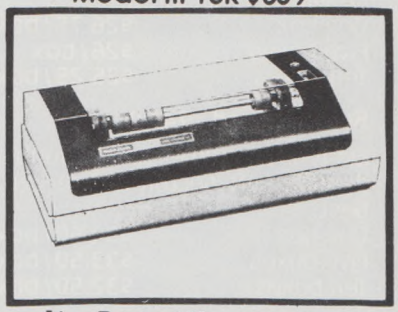
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Listing 1 continued

```
65 CLS:PRINT"CHOICES:":PRINT:PRINT"R  RED":PRINT"O  ORANGE":PRINT"Y  YELLOW
":PRINT"G  GREEN":PRINT"B  BLUE":PRINT"P  PURPLE":PRINT"W  WHITE":PRINT"V
VIOLET"
70 FORI=0TO41:SET(28,I):SET(90,I):NEXT
75 PRINT@46,"CORRECT  CORRECT";:PRINT@110,"COLORS  PLACEMENT";
80 RETURN
84 REM
85 REM  **  OPTIONS LISTING SUBROUTINE  **
86 REM
90 PRINT@896,"PRESS  X  FOR CORRECTION;":PRINT"PRESS  E  TO END TURN. < >";
:CR=984:B$="+":GOTO25
94 REM
95 REM  ** MAIN PROGRAM LISTING **
96 REM
100 RANDOM:CLS:PRINTCHR$(23):PRINT"** COLOR CODE COMBO **":PRINT:PRINT:PRIN
T"(C) 1981 BY D. BISHOP":PRINT"            CUSTOM COMP":GOSUB15
105 PRINT:PRINT:PRINT"HOW MANY COLORS DO YOU":PRINT"WANT TO WORK WITH? (3-8
)":CR=626:B$="+":GOSUB25   :PRINT@626,A:C=A
110 IF C<3 OR C>8 THEN100
115 PRINT:PRINT"HOW LARGE A TABLEAU? (3-8)":CR=758:GOSUB25   :PRINT@758,A:T
=A
120 IF T<3ORT>8THEN100
125 PRINT:PRINT"HOW MANY GUESSES WILL YOU NEED":PRINT"   (4-12)":CR=916:GOS
UB25   :G1=A:IFG1>1THENG=G1ELSEGOSUB25   :G2=A:G=10*G1+G2
130 IFG<4ORG>12THEN100  ELSEPRINT@916,G:POKE 16553,255
134 REM
135 REM  **  RANDOM PROBLEM GENERATOR  **
136 REM
140 DATA "R","O","Y","G","B","P","W","V"
145 FORI=1TO8:READA$(I):NEXT
150 RESTORE
155 R$="":FORI=1TOT:R$=R$+A$(RND(C)):NEXT
156 REM
160 REM  **  SET UP DISPLAY  **
161 REM
165 GOSUB65
170 FORI=0TO8-C:PRINT@640-64*I,"          ";:NEXTI
175 FORI=0TOG-1:PRINT@143+64*I,"#"I+1;:NEXTI
176 REM
180 REM  **  OBTAIN PLAYER'S GUESS  **
181 REM
185 FOR K=1 TO G
190    G$=""
195    FOR L=1 TO T
200       CR=83+64*K+2*L: B$=CHR$(PEEK(15360+CR-1))
205       GOSUB25   : PRINT@CR,A$;
210       G$=G$+A$
215   NEXT L
220   GOSUB90
225   IF A$="X" THEN 190
     ELSE IF A$<>"E" THEN220
230   GOSUB 260
235   PRINT@112+64*K,CC;"      "CP;
240   IF CP=T THEN 325
245 NEXTK
250 GOTO335
251 REM
255 REM  **  SUBROUTINE TO EVALUATE GUESS  **
256 REM
260 RT$=R$:G$=LEFT$(G$,T):CP=0
265 FORI=1TOT
270    IF MID$(G$,I,1)=MID$(R$,I,1) THEN CP=CP+1
275 NEXT
280 J=0:CC=0
285 FORI=1TOT
290    J=J+1
295    IFMID$(G$,I,1)=MID$(R$,J,1)THEN
     CC=CC+1:                                                    R$=LEF
T$(R$,J-1)+" "+RIGHT$(R$,T-J):                          GOTO305
300    IFJ<TTHEN290
305    J=0
310 NEXTI
315 RS$=R$:R$=RT$:RETURN
316 REM
320 REM  **  CONCLUDING RESPONSES  **
321 REM
325 PRINT@896,"CONGRATULATIONS!!          "
330 PRINT"THAT'S IT!  ";:GOTO340
335 PRINT@896,"SORRY... YOU RAN OUT OF TURNS!  THE ANSWER WAS: "R$
340 PRINT"PRESS ANY KEY TO CONTINUE.";:CR=999:B$=" ":GOSUB25
345 GOTO100
```

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- SUM : Performs a checksum.
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- SPLIT : Splits a file into smaller chunks.

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a flashing cursor for the TRS-80.

The program actually begins at line 100 with the title page and the routine for the selection of options (number of colors, size of tableau, number of guesses and, for Apple, color or alphabetic modes to begin with). The code is then randomly generated (lines 134–156), and the program branches to the subroutines that set up the display.

This subroutine is located in lines 60–80 in the TRS-80 code. In the Apple listing, the opening display used depends on whether you are in the color-graphics mode (S=2) or alphabetic mode (S=1).

For color-graphics, the subroutine at 600 is needed to display the line of text in the text window at the bottom of the screen, while the subroutine at 400 sets up the color-graphics display. For alphabetic display, the program branches only to subroutine 600.

The player's guess is obtained in lines 180–215, where the program uses the loop counter L to determine when a color has been entered for each space in the tableau.

The TRS-80 program branches from this routine to the flashing cursor routine, which also contains the INKEY$ function to obtain direct keyboard response.

The Apple color-graphics routine does the same, using the PEEK (-16384) routine. No branch is needed for the Apple alphabetic mode, and thus the subroutine between lines 16–56 can be omitted if you don't use color.

Once the player has entered a complete guess, the programs transfer to the options-listing subroutine (lines 84–94). The program awaits the entry of an X or an E (or an S if in the Apple program).

An X returns the program control to the beginning of the guess-entry loop. An S in the Apple program will convert the display from alphabetic to color-graphics using subroutines 400 and 520, or it will convert the color-graphics display into alphabetic using subroutine 700.

Normal program execution resumes when an E is entered, sending the program to the evaluation subroutine (lines 251–315). Lines 235–240 display the results of the evaluation, and the program then loops back to receive the player's next guess (based on the value of the loop counter K).

When a player guesses the code or runs out of turns, the program jumps to the sequence of lines between 320 and 345 to display the correct code and provide a comment on the game.

Tables 1–3 list the subroutines and the variables used in the programs. There are two modifications to the Apple program that might be desirable in some cases. If the Apple program is not to be used with color, several of the subroutines can be left out, which saves time on entering the program. Lines 16–56, 365–540, 236–237, 201, 221–222, 166 and 131–133 can be omitted. Change line 132 to read 132 S=1, and delete line 91 from the options list. This makes the program considerably shorter, but restricts its use to the alphabetic mode.

A second modification corrects a deficiency in the Apple color-graphics mode that uses the flashing-block cursor. Keyboard response is not very sensitive in this mode and may prove frustrating. A different approach is to avoid the flashing-block marker altogether and simply position the cursor where you want it on the graphics display and use the GET function for keyboard response.

In this mode, the normal cursor shows up as a dark green block just above and to the left of the position where the colored peg will appear. Keyboard response is instantaneous, and the cursor marker does not interfere with the sequence of colored pegs chosen as guesses. To use this mode, insert line 199:

```
199 IF S=2 THEN HTAB H: VTAB V: GET A$: COLOR =0: X=H: Y=2*V: GOSUB 500: GOTO 210
```

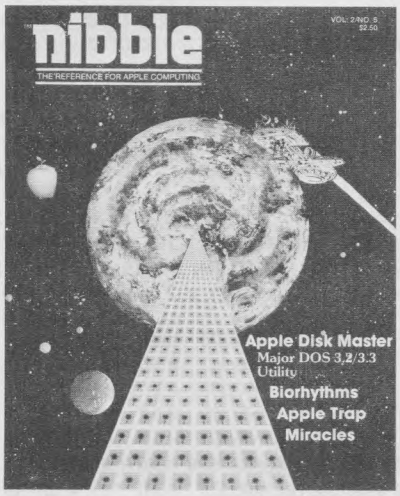
With this option, lines 16–56 can, of course, be removed.■

Listing 2. Apple listing.

```
1  REM   COLOR  DEV. FOR APPLE
2  REM    CODE   BY D. BISHOP
3  REM     COMBO  CUSTOM COMP                    BOX 125
4  REM          BRANSON, MO 65616
5  DIM X$(12),CP(12),CC(12)
6  GOTO 100
9  REM
10  REM  ** DELAY LOOP SUBROUTINE
15  FOR I = 1 TO 5000: NEXT : RETURN
16  REM
20  REM  ** FLASHING COLOR DOT
21  REM
25 ZC =  SCRN( H,2 * V)
26  IF ZB = 5 THEN ZB = ZC: GOTO 30
27 ZB = 5
30  COLOR= ZB: PLOT H,2 * V
35  FOR I = 1 TO 15
40 A = 0:A =  PEEK ( - 16384): POKE  - 16368,0
42  IF A < 128 THEN  GOTO 50
43 A$ =  CHR$ (A - 128)
44 I = 15:F1 = 1: GOTO 50
50  NEXT I
55  IF F1 <  > 1 THEN 26
56 F1 = 0: RETURN
84  REM
85  REM  ** OPTIONS LISTING SUBROUTINE
86  REM
90  HTAB 1: VTAB 23: PRINT "PRESS <X> TO CHANGE GUESS; <E> TO GRADE;";
91  HTAB 10: VTAB 24: PRINT "PRESS <S> TO SWITCH MODES.";
92  GET A$: RETURN
94  REM
95  REM  ** MAIN PROGRAM LISTING
96  REM
100  TEXT : HOME : VTAB 10: PRINT "**  COLOR  **": PRINT "**  CODE   **":
     PRINT "**  COMBO  **": PRINT
101  PRINT "(C) 1981  BY D. BISHOP": PRINT "                CUSTOM COMP": GOSUB
     15
103  FOR I = 1 TO 12:X$(I) = "":CP(I) = 0:CC(I) = 0: NEXT I
105  PRINT : PRINT : PRINT "HOW MANY COLORS DO YOU": INPUT "WANT TO WORK
     WITH (3-8)  ";C
110  IF C < 3 OR C > 8 THEN 100
115  PRINT : INPUT "HOW LARGE A TABLEAU (3-8)  ";T
120  IF T < 3 OR T > 8 THEN 100
125  PRINT : INPUT "HOW MANY GUESSES WILL YOU NEED  (4-12)";G
130  IF G < 4 OR G > 12 THEN 100
131  PRINT : PRINT "WHICH MODE, ";: POKE 50,127: PRINT "C";: POKE 50,255:
```

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Listing 2 continued.

```
      PRINT "OLOR OR ";: POKE 50,127: PRINT "A";: POKE 50,255: PRINT "LPH
     ABET?";: GET A$
  132 S = 1: IF A$ = "C" THEN S = 2: GOTO 140
  133  IF A$ < > "A" THEN 131
  134  REM
  135  REM  ** RANDOM PROBLEM GENERATOR
  139  REM
  140  DATA   "R","B","G","Y","O","W","P","A"
  141  REM
  145  FOR I = 1 TO 8: READ A$(I): NEXT
  150  RESTORE
  155 R$ = "": FOR I = 1 TO T:R$ = R$ + A$( INT ( RND (1) * C + 1)): NEXT
  156  REM
  160  REM  ** SET UP DISPLAY
  161  REM
  165  IF S = 1 THEN  GOSUB 600: GOTO 185
  166  GOSUB 600: GOSUB 400
  176  REM
  180  REM  ** OBTAIN PLAYERS GUESS
  181  REM
  185  FOR K = 1 TO G
  190 G$ = ""
  195  FOR L = 1 TO T
  196 ZZ = 120 + 40 * K + 2 * L:V =  INT (ZZ / 40):H =  INT (ZZ - 40 * V)
  200  IF S = 1 THEN  HTAB H: VTAB V: GET A$: PRINT A$;: GOTO 210
  201  IF S = 2 THEN ZC = 0: HTAB 39: VTAB 24:X = H:Y = 2 * V: GOSUB 25: GOSUB
     500
  210 G$ = G$ + A$
  211 X$(K) = G$
  213 A$ = "":A = 0
  215  NEXT L
  220  GOSUB 90
  221  IF A$ = "S" AND S = 1 THEN  GOSUB 400: GOSUB 520: GOTO 220
  222  IF A$ = "S" THEN S = 1: GOSUB 700: GOTO 220
  225  IF A$ = "X" THEN 190
  226  IF A$ < > "E" THEN 220
  230  GOSUB 260
  235  IF S = 1 THEN  VTAB V: HTAB 26: PRINT CP(K);"  OUT OF  ";CC(K): GOTO
     240
  236 Y = 2 * V:X = 22: COLOR= 1: IF CP(K) < > 0 THEN  FOR J = 1 TO CP(K):
      PLOT X,Y:X = X + 2: NEXT J
  237  IF CC(K) < > 0 AND CC(K) < > CP(K) THEN  COLOR= 15: FOR J = 1 TO (
     CC(K) - CP(K)): PLOT X,Y:X = X + 2: NEXT J
  240  IF CP(K) = T THEN 330
  245  NEXT K
  250  GOTO 335
  251  REM
  255  REM  ** EVALUATION SUBROUTINE
  256  REM
  260 RT$ = R$:G$ =  LEFT$ (G$,T)
  265  FOR I = 1 TO T
  270  IF  MID$ (G$,I,1) =  MID$ (R$,I,1) THEN CP(K) = CP(K) + 1
  275  NEXT
  280 J = 0
  285  FOR I = 1 TO T
  290 J = J + 1
  295  IF  MID$ (G$,I,1) < >  MID$ (R$,J,1) THEN  GOTO 300
  296 CC(K) = CC(K) + 1: IF J = 1 THEN R$ = " " +  RIGHT$ (R$,T - 1): GOTO
     305
  297  IF J = T THEN R$ =  LEFT$ (R$,T - 1) + " ": GOTO 305
  298 R$ =  LEFT$ (R$,J - 1) + " " +  RIGHT$ (R$,T - J): GOTO 305
  300  IF J < T THEN 290
  305 J = 0
  310  NEXT I
  315 R$ = RT$: RETURN
  316  REM
  320  REM  ** CONCLUDING RESPONSES
  321  REM
  330  GOSUB 380: HTAB 1: VTAB 23: PRINT "THAT'S IT!!  CONGRATULATIONS.": FOR
     I = 1 TO 3: CALL 64484: NEXT : GOTO 340
  335  GOSUB 380: FOR I = 1 TO 50:A =  PEEK ( - 16336): NEXT : HTAB 1: VTAB
     23: PRINT "SORRY...  THE ANSWER WAS : ";R$
  336  GOSUB 360
  339  HTAB 1: VTAB 24
  340  PRINT "PRESS ANY KEY TO CONTINUE.";: GET A$
  345  GOSUB 100
```

More →

Listing continued.

```
360  IF S = 1 THEN  HTAB 2: VTAB 19: FOR I = 1 TO T:A$ =  MID$ (R$,I,1): PRINT
     A$;" ";: NEXT I: RETURN
365 X = 2:Y = 10 + 2 * G: FOR I = 1 TO T:A$ =  MID$ (R$,I,1): GOSUB 500:X
     = X + 2: NEXT I: RETURN
380  HTAB 1: VTAB 23: PRINT "
                                        ";: RETURN
400 S = 2: GR
410  COLOR= 1: PLOT 0,39: COLOR= 2: PLOT 5,39
415  COLOR= 4: PLOT 10,39: COLOR= 13: PLOT 15,39
420  COLOR= 9: PLOT 20,39: COLOR= 15: PLOT 25,39
425  COLOR= 11: PLOT 30,39: COLOR= 7: PLOT 35,39
430  IF C < > 8 THEN  COLOR= 0: HLIN (5 * (C - 1) + 1),39 AT 39
435 X = 2:Y = 8
440  COLOR= 5: VLIN 0,35 AT 19
441  HLIN 0,39 AT 8 + 2 * G
443  FOR I = 1 TO 2 * T STEP 2: PLOT 1 + I,1: PLOT 1 + I,2: PLOT 21 + I,1
     : PLOT 21 + I,2: NEXT I
445  IF K = 0 THEN  RETURN
450  FOR I = 1 TO K
455  FOR J = 1 TO T
460 A$ =  MID$ (X$(I),J,1)
465  GOSUB 500
470 X = X + 2: NEXT J
475 Y = Y + 2
480 X = 2: NEXT I
483  GOSUB 520
485  RETURN
500  IF A$ = "R" THEN  COLOR= 1: PLOT X,Y: RETURN
501  IF A$ = "B" THEN  COLOR= 2: PLOT X,Y: RETURN
502  IF A$ = "G" THEN  COLOR= 4: PLOT X,Y: RETURN
503  IF A$ = "Y" THEN  COLOR= 13: PLOT X,Y: RETURN
504  IF A$ = "O" THEN  COLOR= 9: PLOT X,Y: RETURN
505  IF A$ = "W" THEN  COLOR= 15: PLOT X,Y: RETURN
506  IF A$ = "P" THEN  COLOR= 11: PLOT X,Y: RETURN
507  IF A$ = "A" THEN  COLOR= 7: PLOT X,Y: RETURN
509  COLOR= 0: PLOT X,Y
510  RETURN
520  IF K = 1 THEN  RETURN
521 Y = 6
522  FOR II = 1 TO K - 1
523 X = 22: COLOR= 1:Y = Y + 2
525  IF CP(II) < > 0 THEN  FOR J = 1 TO CP(II): PLOT X,Y:X = X + 2: NEXT
     J
530  IF CC(II) = 0 OR CC(II) = CP(II) THEN  GOTO 538
534  COLOR= 15
535  FOR J = 1 TO (CC(II) - CP(II)): PLOT X,Y:X = X + 2: NEXT J
538  NEXT II
540  RETURN
600  HOME : TEXT : VTAB 21: HTAB 1: FOR I = 1 TO 8: PRINT A$(I);"    ";: NEXT

610  PRINT "RED  BLUE GRN  YLW  ORNG WHT  PINK AQUA"
620  FOR I = 1 TO 16: HTAB 20: VTAB I: PRINT "****";: NEXT
630  HTAB 1: VTAB 17: PRINT "****************************************"
640  HTAB 24: VTAB 1: PRINT "CORRECT   CORRECT";: HTAB 24: VTAB 2: PRINT
     "PLACEMENT  COLORS";
650  FOR I = 1 TO G: HTAB 20: VTAB I + 3: PRINT " "I"  ";: NEXT
660  HTAB 1: VTAB 1: FOR I = 1 TO T: PRINT " *";: NEXT I
670  IF C < > 8 THEN  VTAB 21: HTAB (5 * C + 1): FOR I = 1 TO 8 - C: PRINT
     "     ";: NEXT
680  IF C < > 8 THEN  HTAB (5 * C + 1): VTAB 22: FOR I = 1 TO 8 - C: PRINT
     "     ";: NEXT
690  RETURN
700 S = 1
710  TEXT : HOME
715  GOSUB 600
720 H = 0:V = 4
725  FOR I = 1 TO K
730  FOR J = 1 TO T
735 H = H + 2: HTAB H: VTAB V: PRINT  MID$ (X$(I),J,1);
740  NEXT J
750 H = 0:V = V + 1: NEXT I
755 Y = 4
760  IF K < > 1 THEN  FOR I = 1 TO K - 1: VTAB V: HTAB 26: PRINT CP(I);"
       OUT OF ";CC(I);:V = V + 1: NEXT I
770  RETURN
```


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The next time you need a shopping list, use your BASIC interpreter.

The Lazy Man's DBM

By Dave Rose

The TRS-80 is an efficient tool for conquering complicated problems in business and finance. But what if you just want to make a list?

Intricate database management systems are nice, with their multifaceted data arrangement matrices, ultrafast sorts and ability to manage thousands of pieces of information. But what if you only had, say, a dozen pieces of extremely volatile information?

We all have a need for just such lists, whether it be at home or on the job. There is the ever-popular "things to do" list, and the "things to put on the next office supplies order" list, and the "ideas for new programs" list, and the "current credit card balances" list, and the "calendar for next month" list, and the "grocery" list, and the. . .

The Solution

Obviously, spending money on a sophisticated database management (DBM) system just to keep lists is not even remotely justifiable. After sitting for a while staring at a blank TRS-80 screen, I suddenly realized where the answer to this problem lies: in the BASIC language interpreter. And with that realization, I merely typed AUTO, and began composing my first list. That was all there was to it.

A BASIC program is, after all, nothing but a glorified list. It lists commands. If you should happen to list something else, *anything* else, the computer doesn't mind at all (as long as you don't try to run the program). Just enter your list items in place of the usual BASIC statements. Updating, editing, deleting or adding items suddenly becomes child's play using the machine-language editing capabilities already resident in the computer. And you can CLOAD (or LOAD) your list directly, without the BASIC or DBM system middleman. Hard copy is a snap with the LLIST command, and if you're operating under one of the newer DOS systems (or have a copy of RENUM), you even have a renumber capability. Sample runs 1 and 2 show a couple of examples of my own lists using this technique.

After using this Lazy Man's DBM system for a while, I began using the same technique to produce quick little informal notes (see Sample run 3). Since the ability to produce this sort

```
100 '****************************************
110 '***    This is "Things to Do"      ***
120 '****************************************
130 '
140 '
150 ' Take Dog for his Shots
160 ' Pick Up Laundry
170 ' Call TBS (Scripsit Project)
180 ' Pick up Shoes from Repair Shop
190 ' Get tire fixed
200 ' Go by Farmer's Market (corn, peas)
210 ' Flowers for Janey (Anniversary)
220 ' Clean Back Yard Area (Yuk)
230 ' Send Article to Kilobaud (DBM)
240 ' Write Lil in Miami
250 ' Order DLDIS from Instant Software
260 ' Call Sam on that Ski Trip
```

Sample run 1.

Address correspondence to Dave Rose, PO Box 20873, Atlanta, GA 30320.

of text is always resident in my machine, I can pop off one of these little messages whenever the need occurs without having to search around for my copy of Scripsit or scrounge around for a pencil and pad.

You should keep a few things in mind if you decide to give this idea a try. First of all, *always* make the first character typed on any line a single quote (the shorthand character for REM). If you forget to do this and the first character of your list item happens to be a number, BASIC may decide that that number is part of the statement number. This will result in some odd-looking, out of sequence lists or (worse yet) the overwriting of another list element. If your first character is not a single quote and you have a question mark in that list item, BASIC will change that "?" into the word PRINT. And finally, if you should accidently try to run one of your lists, no harm will have been done *if* your list elements all appear to the BASIC interpreter as REMark statements.

If You Have a Disk System

If you own a disk system, you can save a list using the ASCII option (that is, SAVE "Filespec",A), and make it available for processing as a data file. It can then be brought into a BASIC program or Scripsit, or whatever. This is especially useful for lists that require constant revision until they are needed for final or periodic processing.

The BASIC language statement used to input a list element in this fashion is the LINEINPUT#n statement (sequential input, of course). LINEINPUT uses only the enter key as a delimiter, so that each list element is input in its entirety as a single string literal. With Scripsit, the entire list is called at once using the L command. In both cases, the list should have been saved using the A option. The Program listing shows a typical BASIC program that will input a list from disk, sort it alphabetically, renumber it and then print it back onto disk.

Using Your Editor/Assembler

Just one more idea on this subject. If your lists are fairly long and you have a disk-based editor/assembler, you may want to apply the same concept using the editor portion of your editor/assembler. I have the DISKMOD from MISOSYS, which is a modification of Radio Shack's EDTASM. Using DISKMOD instead of BASIC to maintain my longer lists not only gives me the ability to LLIST

```
10 ' ***************************************
20 ' ***        COMP   TIME   LOG         ***
30 ' ***   Line Number Indicates Date     ***
40 ' ***    Extra Hours Were Worked       ***
50 ' ***************************************
60 '
70 '   # hours  -  Reason for Comp Time
80 '
1005 ' 3 hours  -  Midfield Change Project
1011 ' 2 hours  -  Abend, PVU program
1012 ' 1 hour   -  No Lunch (TW3 meeting)
1013 ' 6 hours  -  Midfield Change Project
1015 ' 3 hours  -  October 15 System Purge
1022 ' 8 hours  -  Worked on my Birthday
1028 ' 1 hour   -  MSD program Implemented
1031 ' 2 hours  -  Helped W/Halloween Promo
```

Sample run 2.

Program listing. BASIC List Sort program.

```
100 ' ####   LIST SORT PROGRAM   ####
110 CLS: PRINT: CLEAR 1000
120 DIM A$(100): FL=0: X=0
130 INPUT"NAME OF SOURCE LIST";OL$
140 INPUT"NAME FOR SORTED LIST";SL$
150 OPEN "I",1,OL$: OPEN "O",2,SL$
160 X=X+1: IF EOF(1) CLOSE 1: GOTO 230
170 LINEINPUT#1, A$(X)
```

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Listing Continued.

```
180 '>>>>>>>  STRIP OFF STATEMENT NBR
190 RL=LEN(A$(X))-INSTR(A$(X)," ")
200 A$(X)=RIGHT$(A$(X),RL): PRINT A$(X)
210 GOTO 160
220 '>>>>>>>  THE SORT (BUBBLE)
230 FOR Y=1 TO X-2
240   IF A$(Y+1) >= A$(Y) GOTO 270
250   S$=A$(Y): A$(Y)=A$(Y+1)
260   A$(Y+1)=S$: FL=99
270 NEXT
280 IF FL=99 THEN FL=0: GOTO 230
290 '>>>>>>> RENUMBER AND STORE
300 FOR Y=1 TO X-1
310   B$=STR$(Y*10+100)
320   B$=RIGHT$(B$,LEN(B$)-1)
330   A$(Y)=B$+" "+A$(Y)
340   PRINT A$(Y): PRINT#2, A$(Y)
350 NEXT: CLOSE: END
```

without line numbers (using the T command), but also affords me the flexibility of the F command.

The F command, you will recall, lets you find any given search string almost instantly. Sample run 4 shows a portion of one of the lists I keep in this fashion. It is a list of my *Microcomputing* articles. As you can see, I've given each article several codes. In this way I can get all of the articles on a particular topic by reentering the F command. Here G stands for games, B means the program is in BASIC, "$" refers to business articles, etc.

Now, instead of spending hours going through all of those old copies of *Microcomputing*, I can read in this list, use the F command and know immediately which copy I need.

Actually, you could emulate a very sophisticated in-memory information system using this concept. If you've thought about getting such a system but didn't want to spend the money, perhaps this will do instead. The only feature missing is the sort, but a sort may not be one of your requirements. Of course, sorting *could* be done in BASIC.■

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```
100 '
110 '
120 '  Sarah,
130 '     I've been looking over Form 3
140 '  (you know, the "Payment Overdue"
150 '  letter).  It seems to me that it
160 '  would flow a little more smoothly
170 '  if paragraphs 2 and 3 were switched.
180 '  When you have a chance, please take
190 '  a look at it for me and see if you
200 '  don't agree....
210 '
220 '                                Thanks,
230 '
240 '                                     Dave
```

Sample run 3.

```
00021 FLYING *** :B:G: *** KB 04/79, PG 68
00022 WAIT STATES *** :T: *** KB 04/79, PG 76
00023 QUIKSORT *** :B:S:U: *** KB 04/79, PG 96
00024 DBM *** :T:$: *** KB 05/79, PG 54
00025 DARTS *** :B:G: *** KB 05/79, PG 78
00026 MONITOR *** :B:U: *** KB 06/79, PG 26
00027 HANDLES *** :B:G: *** KB 06/79, PG 58
00028 TVI *** :C:F:T: *** KB 06/79, PG 84
00029 HUH? *** :H:R: *** KB 07/79, PG 40
00030 NERVES *** :B:G: *** KB 08/79, PG 100
00031 LEV "III" *** :H:R: *** KB 10/79, PG 72
00032 PRESTEL *** :C:R:T: *** KB 10/79, PG 94
00033 ARENA *** :B:G: *** KB 10/79, PG 110
00034 779 PRNTR *** :H:R: *** KB 10/79, PG 120
00035 PIG LATIN *** :B:G: *** KB 10/79, PG 162
00036 TOUCH *** :B:G: *** KB 10/79, PG 166
00037 ESCON *** :H:R:C: *** KB 11/79, PG 42
00038 NEWDOS+ *** :A:R:C: *** KB 11/79, PG 78
00039 WARI *** :B:G: *** KB 11/79, PG 118
00040 SECRETARY *** :B:$: *** KB 04/80, PG 58
00041 FORTRAN! *** :T:F:C: *** KB 02/80, PG 202
00042 FREE BOOKS *** :C:T:F: *** KB 12/79, PG 130
```

Sample run 4.

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Build your own 16/32K dynamic RAM memory board for the SWTP 6800 computer.

RAM Dynam'

By Gary Wachter

It was hard to believe, but the time had finally come. All of the 50-pin memory slots in my SWTP 6800 had been filled. This made the case nice and full, but left me with only 20K of memory. With a disk operating system using a 4K chunk and BASIC gobbling up another 9K, this left only 7K of workable memory.

Several options were available if I desired more memory. A second motherboard could be paralleled to the existing board. This, though, had several distinct drawbacks. First, there was a good chance that increased bus noise could cause some reliability problems. Second, the power supply would have to be beefed up to handle the additional load. I would also have to find a case to enclose the additional boards. This all added up to a great expense. I quickly abandoned pursuit in this direction.

Another approach would be to replace the existing 4K memory boards with new ones having 16K or even 32K densities. Even though prices were dropping, the cost of purchasing complete high-density memory boards could make a substantial dent in my budget.

The prices of 16K×1 RAMs were also dropping substantially. I could realize some savings if I purchased only the chips and constructed the rest of the board myself. At last, this seemed the way to go. But there was still a black cloud looming on the horizon. Those 16K memory chips were dynamic, and *everyone* knows that dynamic memories never work right!

Pure bunk! Disproving this myth was all the incentive I needed to begin this project. Besides, having 32K on only one board would cut down on the power consumption and free up a lot of space on the motherboard. I soon discovered that implementing a high-density dynamic memory system was not all that difficult if guidelines were followed. In over three months of operation, this 32K memory card has never caused an error of any kind.

I originally planned to build a prototype board using wire-wraps to facilitate the many changes needed during the early phases of construction. I would then build a second board of the final model with optimum layout. The original prototype worked out so well that I decided not to build the second board.

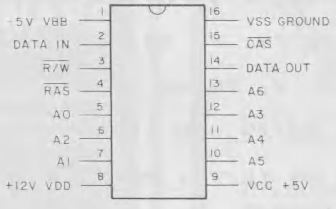
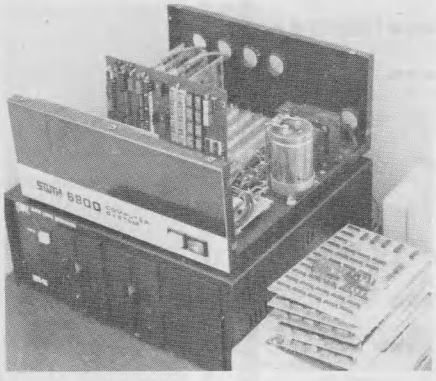


Fig. 1. 4116 RAM, top view.



Memory board operating in the computer. Note stack of memory boards to the right that it replaced.

Description

At today's price of about $30 for eight dynamic RAMs (of the type used by the TRS-80), this board costs only about $100.

Operation of this board is also possible with only 16K by placing eight memory chips in IC sockets 1–8. The jumpers on the DIP header can be configured in such a way that these chips will be enabled by either the lower or the upper 16K addresses.

The memory chip in the spotlight is the Mostek 4116, which is a 16K×1 dynamic RAM (see Fig. 1). The operation of a dynamic RAM vs a static RAM requires that the dynamic unit be periodically refreshed or "recharged" or it will lose its stored data. It comes in a 16-pin package and requires +12 V, +5 V and −5 V. The power-supply tolerance is plus or minus 10 percent. Separate data in and out lines are provided. Address selection is accomplished with seven lines. To keep the size of the package down, the manufacturer resorted to a multiplexing technique for address selection.

The 14-bit address is broken down into two parts and fed sequentially to

Address correspondence to Gary Wachter, 7405 Old Spanish Trail, San Antonio, TX 78233.

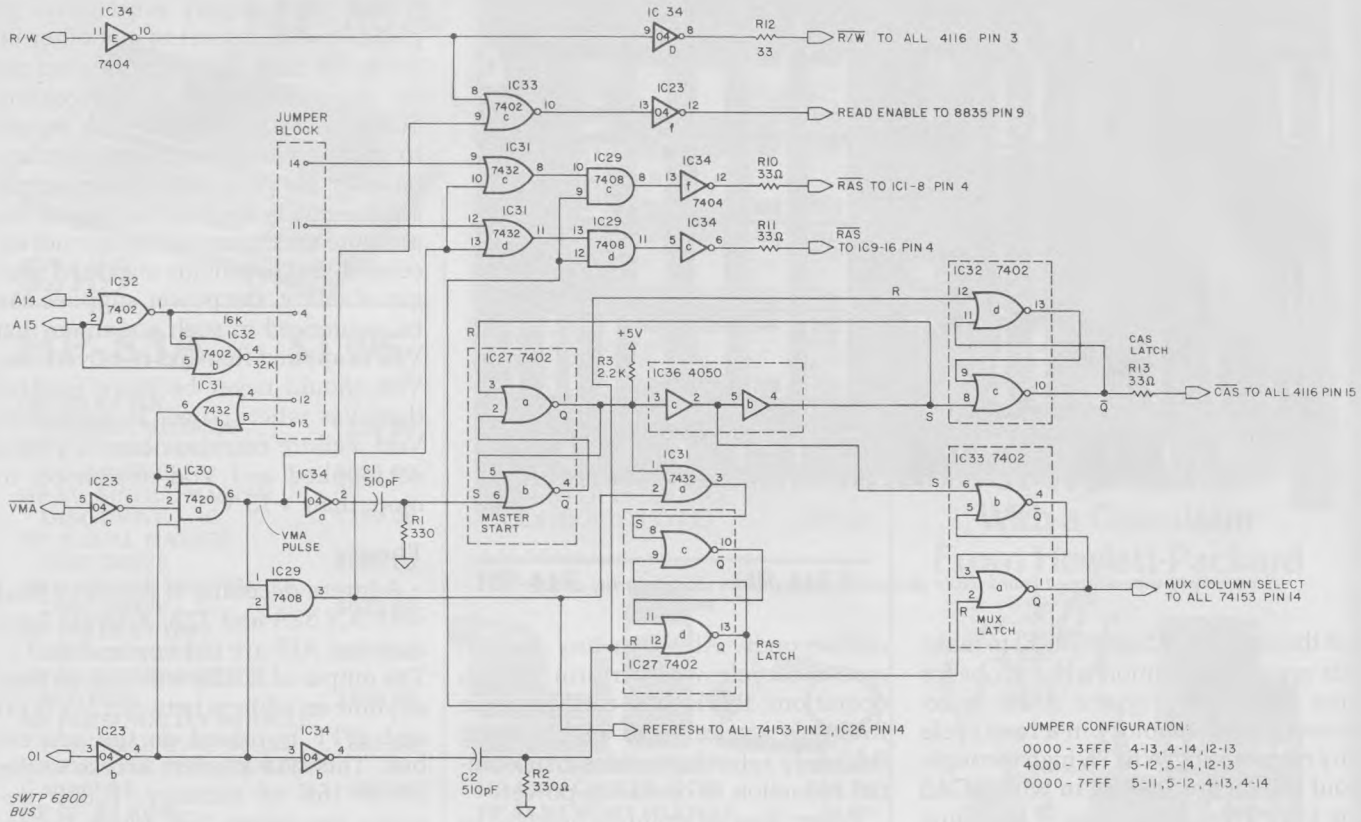


Fig. 2. 16/32K dynamic RAM control.

the chip with a data selector. Direct interfacing with Schottky TTL is no problem. With some layouts, it may be advisable to insert a low-value series damping resistor into each line to reduce ringing effects. Since a chip enable pin is not provided with the board, Row Address Select (RAS) and/or Column Address Select (CAS) can be decoded for chip selection.

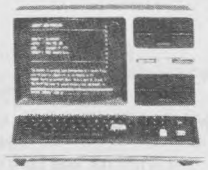
Addressing. The 14-bit address is divided into two groups of seven bits each. The first group of seven bits is fed to the address inputs of the memory chips through data selectors. The RAS line is brought low and the row address latches into the 4116. The data selector switches over to the second group of seven bits and the CAS line is brought low. This latches in the column address. After this multiplexing takes place, data may be read in or out.

Data I/O. Data to be written into a selected cell is latched into an on-chip register with a WRITE and a CAS while RAS is active. The latter

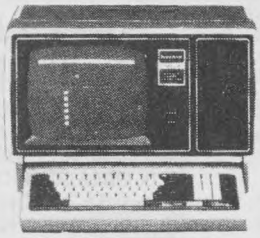
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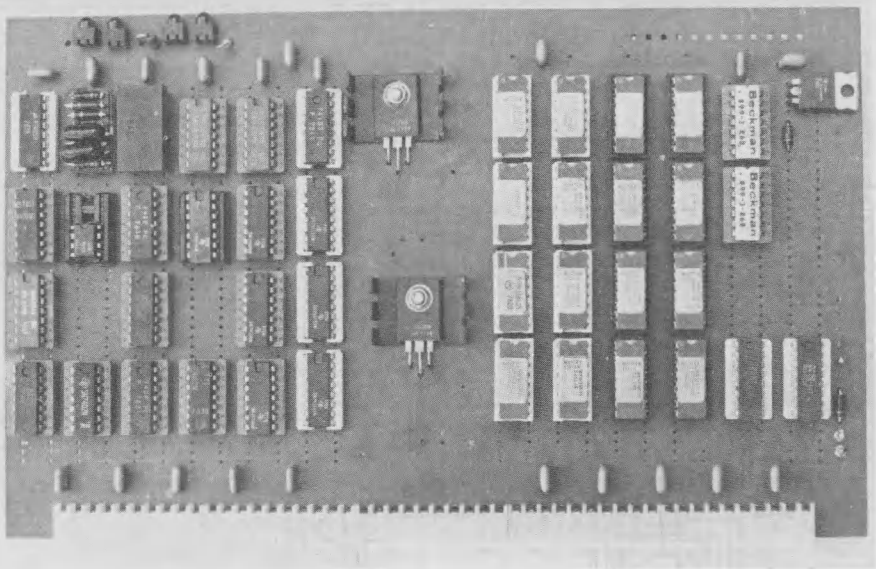
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Rear view of wire-wrapped board. Note decoupling capacitors in memory array at left.

of the signals (CAS or WRITE) to make its negative transition is the strobe for the DATA IN register. Data is retrieved from memory in a read cycle by maintaining WRITE high throughout the memory cycle in which CAS is low. The output data is the same polarity (no inversion takes place) as the input data. Once having gone active, the output will remain valid until CAS is taken to the logic 1 state.

Refresh. Refreshing the dynamic memory cells can be accomplished by performing a memory cycle at each of the 128 row addresses every two milliseconds. Although any normal memory cycle will perform refresh operations, this is most easily done in RAS-only cycles (CAS high). Using RAS-only refresh provides a substantial reduction in operating power.

Power. Special attention needs to be paid to the power supply. Most of the power drawn by the chip is as a result of an address strobe edge. All power supplies have a ten percent tolerance. Decoupling should be used to suppress high-frequency noise resulting from the transient current of the device. Power lines at each chip were decoupled with a .1 uF capacitor.

The −5 V supply must never go positive with respect to any other input to the chip. If it does, the chip can be easily damaged. A high-current Schottky diode from the −5 V supply to ground can protect against many hazards. No particular power-supply sequencing is required as long as the absolute maximum ratings are not exceeded. But to provide an added margin of safety, the power supplies can be sequenced in such a manner that Vbb is applied first and removed last. Vbb should never be more positive than Vss when power is applied to Vdd. Failure can also occur if Vbb is not applied and Vdd overshoots to more than +15 V.

Theory

Address decoding is accomplished with ICs 32A and 32B. Address lines A14 and A15 are fed to pins 3 and 2. The output of IC32A will then go high anytime an address between hex 0000 and 3FFF is placed on the address bus. This will provide access to the lower 16K of memory. IC32B decodes the upper 16K block by responding to any address between hex 4000 and 7FFF (see Fig. 2).

The jumper block was incorporated to provide extra flexibility. You can install only 16K of RAM and have it respond to either the upper or lower 16K block by following the jumper configuration in Fig. 3.

Designation	Type	Description
IC17,18	8835	Quad bidirectional transceiver
IC23-25,34	74S04	Hex inverters
IC19-22	74S153	Dual 4-input data selector
IC27,32,33	7402	Quad NOR gates
IC29	7408	Quad AND gates
IC30	7420	Dual NAND gates
IC31	7432	Dual OR gates
IC36	4050	CMOS hex buffer
IC39	7905	−5 V regulator
IC37,38	7805	+5 V regulator
IC1-16	4116	16K RAM memories
R1,2	330 Ohm	1/4 Watt resistor
R3	2.2k Ohm	1/4 Watt resistor
R5,7	100 Ohm	1/4 Watt resistor
R8	150 Ohm	1/4 Watt resistor
R9	39 Ohm	1 Watt
R10-20	33 to 68 Ohm	1/4 Watt damping resistors
C1,2	510 pF.	mica capacitor
C3-6	10 uF.	25 V electrolytic capacitor
C9-65	.1 uF.	25 V bypassing capacitors
D1-4		LED
D5		Schottky diode, 1 Amp/50 V min.
D6		12 V zener diode, 1 Watt min.

Parts list.

With 16K of memory placed in sockets 1-8

address response; 0000-3FFF, Jumper: 4-13, 4-14, 12-13

4000-7FFF, Jumper: 5-12, 5-14, 12-13

Operations with all 16 chips for 32K operation, address enabling 0000-7FFF; Jumper: 5-11, 5-12, 4-13, 4-14

Fig. 3. Jumper table.

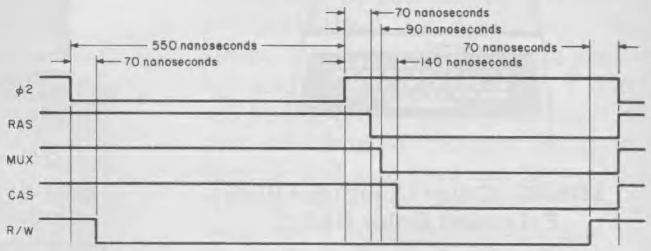
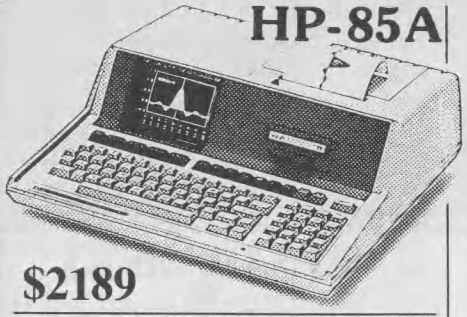


Fig. 4. Chip timing.

	74S153 pin 2	pin 14
Row address select	0	0
Column address select	0	1
Refresh address select	1	0

Fig. 5. Data selector truth table.

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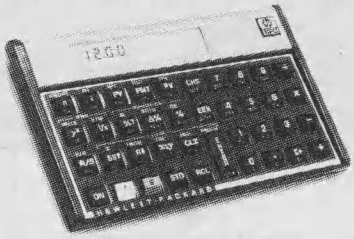
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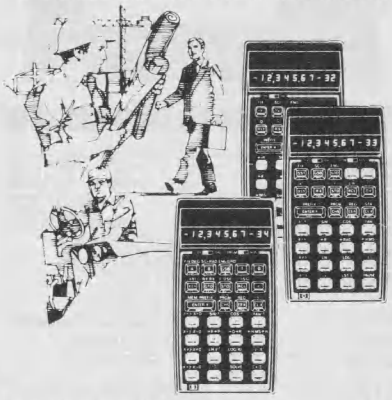
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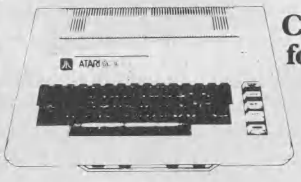
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Valid board addresses are determined by NAND gate IC30. The VMA line from the system bus is buffered and inverted by IC23C, then fed to IC30. The phase Ø2 clock is handled in the same way by IC23B. OR gate IC31B feeds IC30 with a positive-going pulse from the address-decoding section. When all the inputs to IC30 are high, the output goes low. This starts a chain of events providing read/write access during the active portion of the phase Ø2 clock.

An R/S flip-flop formed by two NOR gates, ICs 27A and 27B, is negative edge triggered by the valid memory pulse through IC34A, C1 and R1. The Q output of this flip-flop feeds a delay line composed of CMOS buffers. Each CMOS buffer provides approximately 50 ns delay when operated at +5 V. When cascaded, a delay line with taps every 50 ns is created. R3 aids in transition from TTL to CMOS. See Fig. 4 for timing signals.

The output pulse of the master start flip-flop passes through OR gate IC31A to the RAS latch, composed of ICs 27C and 27D. This flip-flop brings the RAS line active until reset.

The first tap in the delay line trips the multiplex latch, which is a flip-flop formed by ICs 33A and 33B. The Q output goes to pin 14 of all 74S153 data selectors; this will command the data selectors to move from the row address to the column address. The column address is held until the MUX latch reset.

> Disproving the dynamic memory myth was all the incentive I needed to begin this project.

The output of the first delay line trips the CAS latch and also resets the master start flip-flop. The inverted Q output of this flip-flop, ICs 32C and 32D, is the column address strobe that connects directly to all 16 memory chips. This CAS line is held low until reset. The line that resets the RAS, CAS and MUX latches is formed by the falling edge of the phase Ø2 clock. The inverted phase Ø2 clock signal of IC23B goes to negative edge trigger IC34B, C2 and R2. This forms the master reset pulse.

The R/W pulse from the bus is buffered and inverted by IC34E. IC34D restores the pulse to its original polarity and drives all memory R/W pins.

Memory chip enabling is done by manipulation of the RAS line through ICs 31C and 31D and ICs 29C and 29D. The address block enable from ICs 32A and 32B are jumpered to OR gates ICs 31C and 31D for access to the lower or upper 16K of memory block. The OR gate outputs are passed along to AND gates ICs 29C and 29D

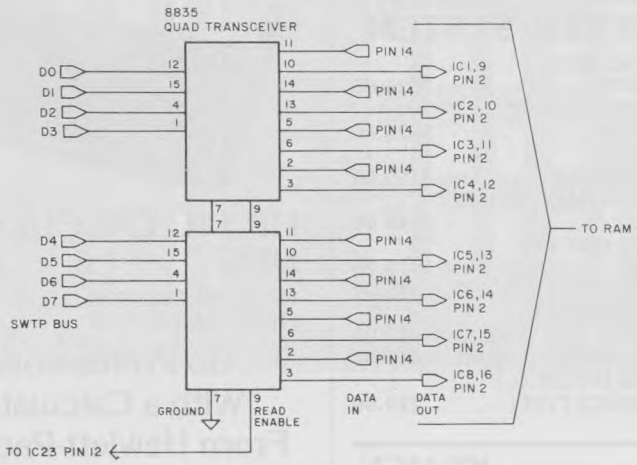


Fig. 6. Data transceivers.

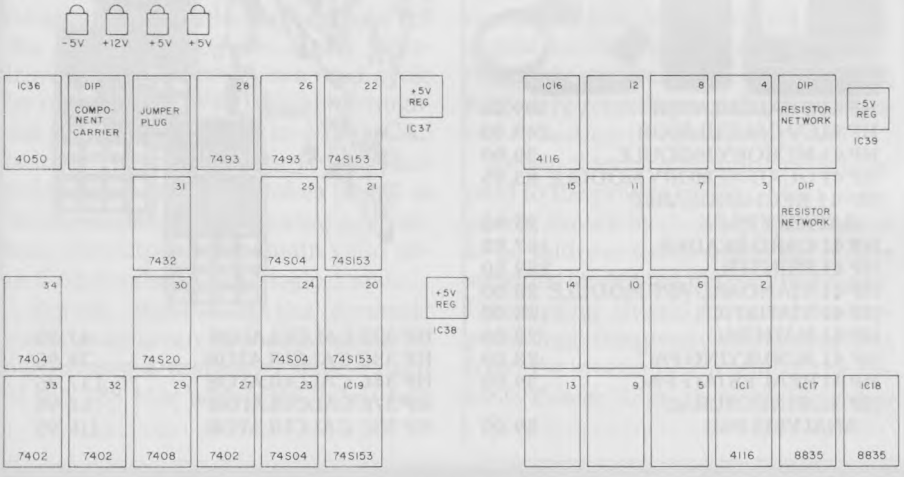


Fig. 7. 32K RAM board layout.

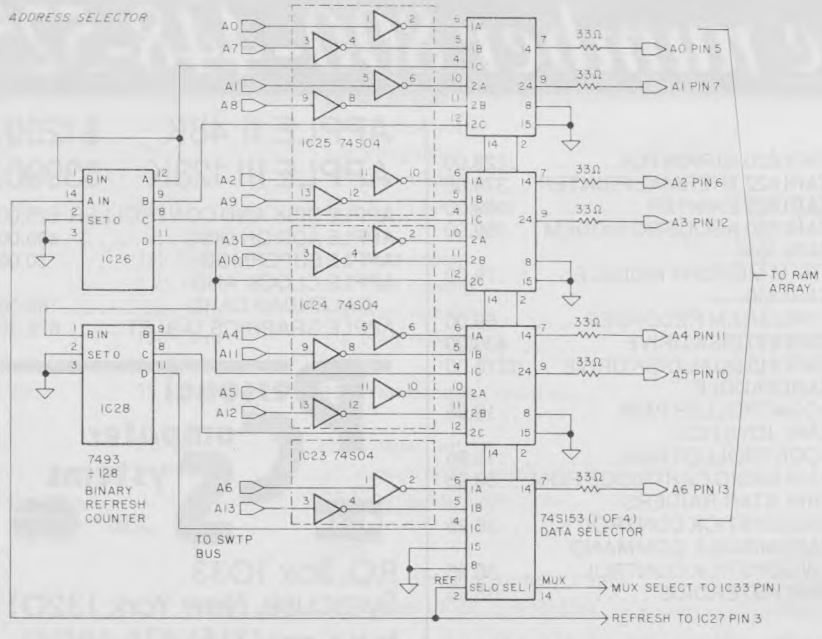
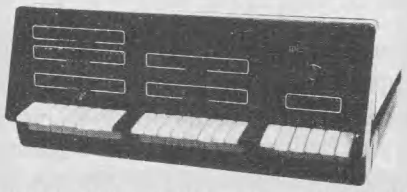


Fig. 8. 16/32K RAM address/refresh selector.

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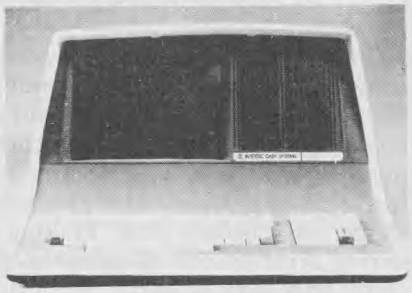
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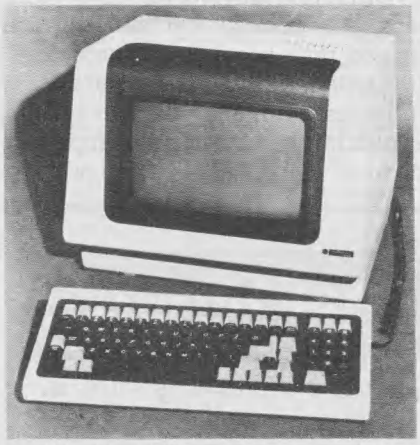


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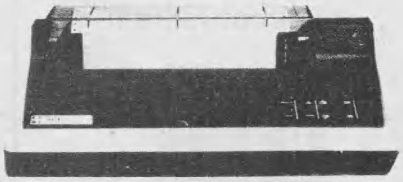
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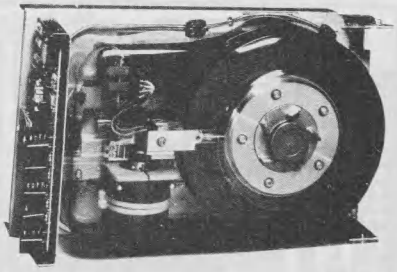
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where presence of an active RAS command is checked. If both RAS and respective address enable pulses are present, the output of the appropriate AND gate goes low. This low-going RAS line enables the selected memory block.

Refresh

Refresh cycles are performed whenever a read or write cycle is not in progress. The process is transparent, which means that it does not steal cycles from the CPU or otherwise slow down execution time. AND gate IC29A checks the state of the valid memory line during clock phase Ø2. If the board is not called on by the CPU during a given cycle, a refresh operation is performed. The output of IC29A goes high and trips the RAS latch through IC31A. The RAS lines of all 16 memory chips are enabled through ICs 31C and 31D. The actual RAS pulse arrives at ICs 29C and 29D about the same time. This sends the chip RAS line low until reset, thus completing the refresh period.

The two 7493s are arranged in a divide-by-128 binary counter that advances on the negative edge of the refresh pulse. This counter contains the refresh address.

With this arrangement, many more complete refresh cycles are performed than are actually necessary. This will not harm the memory chips or decrease reliability. I tried several refresh inhibit circuits, which proved to cause more harm than good. The power consumption alone from the additional TTL chips offset the power savings from limiting refresh cycling. To keep the board as simple as possible, I did not incorporate a refresh inhibit circuit.

The 74S153 data selector is used for refresh and address selection. Pole A contains the row address, B the column and C the refresh address. A truth table can be found in Fig. 5. The 8835 bidirectional data transceivers are the direct link between the system bus and the memory chips, as can be seen in Fig. 6.

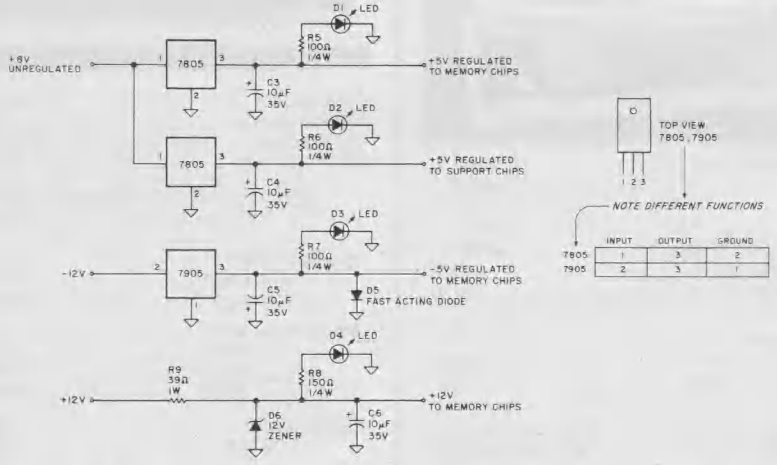


Fig. 9. 16/32K RAM power supply.

Construction

The parts layout in Fig. 7 has worked satisfactorily. Insert IC memory sockets as shown. Connect ground and Vcc to the buses provided on the board. Decouple each power supply lead on every chip with a .1 uF capacitor. To wire up the memory array, wire the following pins—1, 3, 4, 5, 6, 7, 8, 10, 11, 12, 13, 15—on all memory chips in parallel. The Vbb and Vdd pins should each be connected to the output of the respective power supply. Connect the data in and out pins to the 8835 transceivers as shown in Fig. 6.

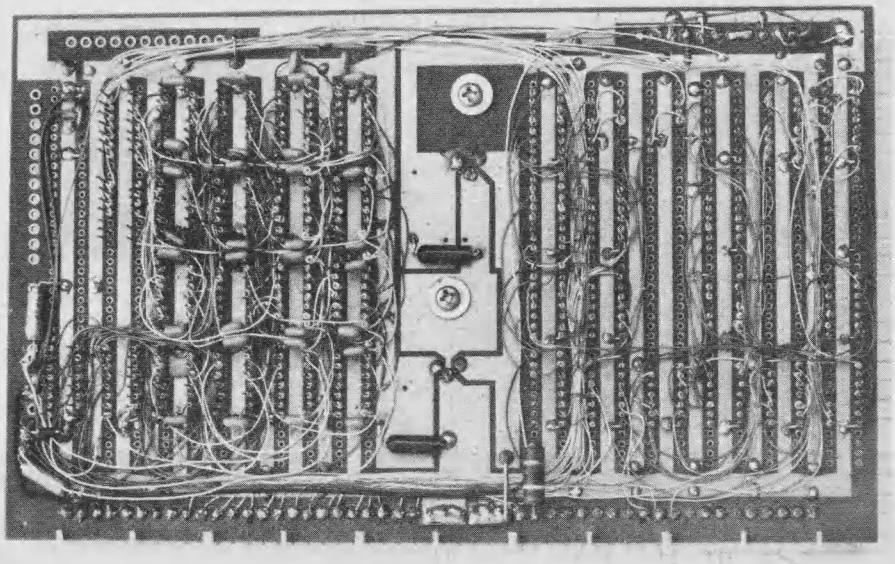
Connect the remaining pins to the controller as shown in Figs. 2 and 8. Keep the wiring neat and as short as possible. This is a must! Check continuity of the memory IC sockets before applying power. Also check for shorts on adjacent pins. Finding a wiring error before plugging in the chips will save a lot of debugging time later.

When wiring of the board has been completed, plug it into the computer and verify the voltages on the IC sockets. When wiring and preliminary checkout have been completed, insert ICs into their sockets and configure the DIP header with the appropriate jumpers for the amount of memory in use (see Fig. 3).

The −5 V regulator does not need a heat sink since it hardly even warms up. An LED connected across the output of each power supply, Fig. 9, provides a visual indication of power-supply operation.

Conclusion

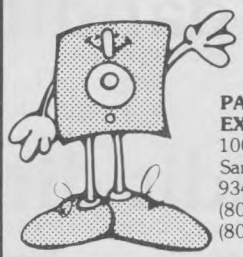
It was well worth the time to design and build this board. I'm quite pleased with the savings in space and reduced power consumption. Unfortunately, I will have to find another place to warm up TV dinners since the computer case has cooled down!■



Front view of board. LED indicators are at top left; +5 V regulators are in middle; −5 V regulators are at right. DIP resistor networks at top right are used for series damping.

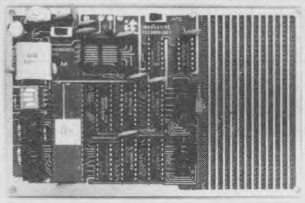
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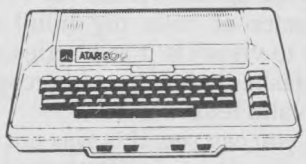
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Didahdidit dit didah didahdit dahdit Dah didididit dit Dahdidahdit dahdahdah dahdidit dit!

By Dean J. Carter

If you'd like to become an amateur radio operator, but think that learning Morse code is too difficult, take a look at this program. You might be on the air before you know it.

In the old days (before microcomputers), if you wanted to learn the code someone would give you a sheet of paper with dots and dashes and letters on it. You would then study it, memorizing every dot and dash. That's what I did, and because of it I had a very hard time increasing my code speed. Whenever I heard a character of code my mind would have to visualize it as a series of dots and dashes before I could recognize it as a valid letter.

As you can see, this was not a very desirable situation. I became so frustrated that I gave up amateur radio and became a CBer (gasp!).

After the CB boom made a mess of the channels, I decided to give amateur radio and the code another try. This time I managed to get my novice license without too much trouble by going to local amateur radio classes. But when I tried to increase my speed enough to understand what was being sent on the novice bands, I ran into the same trouble. I gave up amateur radio once more and became a computerist.

I had my Apple II for a few months before I started to think about amateur radio again. I had seen some programs that could read Morse code, but found that they really didn't work very well unless the sender had a very good fist (sent code well). Besides, using a computer on the novice bands would be cheating.

So I decided to let my computer teach me the code in the proper manner, the way I should have learned it to start with. Thus Code Teacher was developed. I think you will find it different from any other code practice program you have seen.

The Morse Code

First a few words about the structure of the Morse code itself are in order.

The dot, or dit as it is commonly called, is the basic element used for timing. If the dot is considered as being one unit of time in length, then the dash, or dah, is three units; i.e., three times longer than a dot. There is one unit of time between the elements (dots and dashes) of a character and three units between the characters in a word. And finally, seven units of time make up the space between words.

The Code Teacher program (Listing 1), like any other Morse code program, is designed around these timing units. The difference is that the Code Teacher allows the code speed and the number of elements between characters to be set separately. This permits the code speed to be set high and the character spaces to be set long (more elements per space than normal).

This turns out to be the best way to learn the code, because you hear how the characters should sound at advanced operating speeds. The upgrading of your license from novice to general class will be made much easier.

Program Operation

The Code Teacher makes use of the Apple's built-in speaker to send the Morse code characters. It is designed to be as flexible as possible to allow the user to adjust it to his own learning speed.

On running the program, you are requested to input some information. First, code speed is requested. The beginner should start with at least 20 words per minute. Don't let this scare you off. It's not as bad as it sounds because you'll have lots of time to think between those 20-word-per-minute characters.

Which brings us to the second item requested by the program—elements per character space. This is the length of time that the computer will wait before sending the next character. The normal number of elements between characters is three, but start with 40 or 50 (or more) and reduce the number when you feel you can.

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The important thing here is that you are hearing the characters at 20 or more words per minute and are working on reducing the time it takes to recognize the sound of each one. By doing it this way you can avoid the ten-word-per-minute barrier that so many people find themselves up against.

Next, you need to enter the number of times you want each character repeated. Three of four times should be good for beginning.

The program will give you a choice of three modes of operation: keyboard entry, problem characters and random characters.

The keyboard entry mode allows you to type a character and hear it right away. This mode is useful for those who have no prior experience with the code. It permits them to become familiar with selected characters and compare their sounds, such as the progression of the numbers. To leave this mode hit return.

The problem characters mode lets you type in the characters that you're having trouble recognizing and then sends them in random order. This mode can also be used for learning the code a few characters at a time. To stop the sending, hit any key.

The random characters mode is the one most often used for code practice. When it is selected you will be given the choice of listening to letters only, letters and numbers, or letters, numbers and punctuation. Start with letters and move on to numbers and punctuation later. Hitting any key will stop the sending and restart the program.

In all of the preceding modes of operation, the character is printed on the screen after the code has been sent. It will appear just before the next character is sent.

Program Outline

The following is an overview of the program by line number. A more detailed description of the important routines will be given later.

Lines 10–30: Poke a machine-language subroutine into memory. This subroutine produces the audio tones.

Lines 40–60: Dimension string arrays for manipulating the code data. Set up tone routine variables.

Lines 80–180: Input the desired code speed and set the dot length variable (D0) accordingly. Note: CALL –958 in line 180 clears the screen from the cursor to the end of the page.

Line 190: Sets the dash length variable (D1) to three times the dot length.

Lines 200–210: Input the desired amount of space between each character sent (elements per character space) and input the desired number of times to repeat each character. Variables D2 and RP respectively.

Lines 220–230: Set up string arrays

```
10  POKE 16346,165: POKE 16347,0: POKE 16348,240: POKE 16349,3: POKE 16350
    ,173: POKE 16351,48: POKE 16352,192: POKE 16353,136: POKE 16354,208:
20  POKE 16355,4: POKE 16356,198: POKE 16357,1: POKE 16358,240: POKE 16359
    ,8: POKE 16360,202: POKE 16361,208: POKE 16362,246: POKE 16363,166:
30  POKE 16364,0: POKE 16365,76: POKE 16366,218: POKE 16367,63: POKE 16368
    ,96:
40  CLEAR
50  DIM A$(48),CR$(48),CH$(48),AA$(48)
60 D = 1:F = 0:F1 = 72:F0 = 0:TN = 16346
70  HOME : PRINT  TAB( 14)"CODE TEACHER": PRINT
80  INPUT "ENTER CODE SPEED (5 THROUGH 35 IN STEPS OF 5)>":CS
90  IF CS = 0 GOTO 180
100  IF CS = 5 THEN D0 = 85
110  IF CS = 10 THEN D0 = 42
120  IF CS = 15 THEN D0 = 25
130  IF CS = 20 THEN D0 = 17
140  IF CS = 25 THEN D0 = 13
150  IF CS = 30 THEN D0 = 10
160  IF CS = 35 THEN D0 = 8
170  GOTO 190
180  VTAB 3: CALL  - 958: INPUT "ENTER SPEED VALUE (1 TO 85)>":D0
190 D1 = D0 * 3: REM :DAH LENGTH
200  INPUT "ENTER # OF ELEMENTS/CHARACTER SPACE >":D2
210  INPUT "ENTER # OF TIMES TO REPEAT EACH LETTER ":RP
220  FOR X = 1 TO 48: READ CR$(X): NEXT
230  FOR X = 1 TO 48: READ A$(X): NEXT
240  PRINT "DO YOU WANT TO :"
250  PRINT "(1) INPUT THROUGH KEYBOARD "
260  PRINT "(2) ENTER PROBLEM CHARACTERS "
270  INPUT "(3) RECEIVE RANDOM CHARACTERS ":KB
280  ON KB GOTO 620,510,290
290  PRINT "DO YOU WANT :"
300  PRINT "(1) LETTERS"
310  PRINT "(2) LETTERS & NUMBERS"
320  INPUT "(3) LETTERS, NUMBERS & PUNCTUATION ":CR: HOME
330  IF CR = 1 THEN CR = 26
340  IF CR = 2 THEN CR = 36
350  IF CR = 3 THEN CR = 48
360 B =  INT (CR *  RND (1)) + 1
370  GOSUB 390: IF  PEEK ( - 16384) > 127 THEN  POKE  - 16368,0: GOTO 40
380  POKE  - 16368,0: GOTO 360
390  FOR Y = 1 TO RP
400  FOR X = 1 TO  LEN (A$(B))
410 F1 =  PDL (0): POKE F,F1: REM SET TONE
420  IF  MID$ (A$(B),X,1) = "1" THEN  POKE D,D1: CALL TN: GOTO 440: REM
    SEND A DAH
430  POKE D,D0: CALL TN: REM  :SEND A DIT
440  POKE F,F0: POKE D,D0: CALL TN: REM :ELEMENT SPACE
450  NEXT
460  FOR W = 1 TO D2 - 1: REM  :CHARACTER SPACE LOOP
470  POKE D,D0: CALL TN
480  NEXT
490  PRINT CR$(B);" ";
500  NEXT : RETURN
510 C = 0:C1 = 0: HOME
520  PRINT : INPUT "ENTER PROBLEM CHARACTERS>";P$
530 CR =  LEN (P$)
540 C = C + 1:C1 = C1 + 1: IF C > CR THEN 600
550 P1$ =  MID$ (P$,C,1)
560  FOR B = 1 TO 48
570  IF P1$ = CR$(B) THEN CH$(C1) = P1$:AA$(C1) = A$(B): GOTO 540
580  NEXT : PRINT : PRINT P1$;" IS NOT A VALID CHARACTER"
590 C1 = C1 - 1: GOTO 540
600 CR = C1 - 1: FOR B = 1 TO CR
610 CR$(B) = CH$(B):A$(B) = AA$(B): NEXT : GOTO 360
620  GET AA$: IF AA$ =  CHR$ (13) THEN  GOTO 40
630  FOR B = 1 TO 48
640  IF AA$ = CR$(B) THEN  GOSUB 390: GOTO 620
650  NEXT : GOTO 620
660  DATA A,B,C,D,E,F,G,H,I,J,K,L,M,N,O,P,Q,R,S,T,U,V,W,X,Y,Z
670  DATA 1,2,3,4,5,6,7,8,9,0
680  DATA .,",",?,-,":",;,(,/,WAIT,AR,SK,ERROR
690  DATA 01,1000,1010,100,0,0010,110,0000,00,0111,101,0100
700  DATA 11,10,111,0110,1101,010,000,1,001,0001,011,1001,1011,1100
710  DATA 01111,00111,00011,00001,00000,10000,11000,11100,11110,11111
720  DATA 010101,110011,001100,10001,111000,101010,101101,10010,01000,0101
    0,000101,00000000
990  REM :CALIBRATE ROUTINE
1000  HOME
1010 X = 0
1020  POKE F,F1: POKE D,D0: CALL TN: REM :SEND A DIT
1030  POKE F,F0: POKE D,D0: CALL TN: REM :ELEMENT SPACE
1040 X = X + 1: PRINT X;
1050  GOTO 1020
1060  REM :CODE SPEED IN WORDS PER MINUTE=DOTS PER MIN / 25
1070  REM
1080  REM  +--------------+
1090  REM    CODE TEACHER
1100  REM   BY DEAN CARTER
1110  REM  +--------------+
```

Listing 1. Code Teacher program for the Apple II.

CR$(X) and A$(X) with character data and code data respectively.

Lines 240-280: Input the desired mode of operation and transfer control to the proper area of the program.

Lines 290-350: Input the desired subset of characters to be sent.

Line 360: Generates a random number in the proper range for the set of characters chosen. This number is then used by the code generation routine.

Lines 370-380: Go to the code generation subroutine, check for a keypress for restarting the program, loop to line 360 for a new random number. Note: PEEK (-16384) reads the keyboard address. If it is greater than 127 then a key was pressed. POKE -16368,0 resets the keyboard strobe after reading.

Lines 390-500: Code generation routine. Use the data stored in the A$(X) string array to form the code characters. This routine also prints the corresponding alphanumeric character on the screen after the code has been sent.

Lines 510—610: Problem character routine. This routine rearranges the data in the string arrays holding the code and characters (A$(X) and CR$(X)) so that the user can create his (or her) own subset of characters.

Lines 620-650: Keyboard entry routine. Input single characters from the keyboard, find the correct entry in the CR$(X) array, and go to the code generation subroutine.

Lines 660-680: Character data for the CR$(X) array. Note: The comma and colon in line 680 must be in quotations or they will not be accepted as data.

Lines 690-720: Code data for the A$(X) array. Zero is a dot, one is a dash.

Lines 1000-1060: Calibrate routine. Sends a continuous string of dots, and counts them until a control-C is pressed.

The Code Generation Routine

The code generation routine is the heart of the program. It is called via a GOSUB whenever a character is ready to be sent. Twelve variables are involved with this routine, but after the program options are set by the user, only one variable changes from character to character. The variables that are used are listed in Table 1.

The DATA statements and the string arrays (CR$(X) and A$(X)) are the key to the code generation routine. The DATA statements are organized as two sets of 48 data elements. The first 48 data elements (lines 660-680) consist of the characters that will be printed on the screen after the corresponding character of code has been sent. The following 48 data elements (lines 690-720) are the actual code elements to be sent. The dots and dashes are represented by zeros and ones respectively. The letter A, for example, is represented in the DATA statement as "01" (dot dash). The FOR loops in lines 220 and 230 load the contents of the DATA statements into the string arrays CR$(X) and A$(X). With this information we can now go through the code generation routine line by line to see how it functions.

Line 390: Loop for repeating a character the selected number of times.

Line 400: This loop determines how many passes will be made through the routine to send the entire character selected in A$(B).

Line 410: Reads the game paddle setting and passes its value to the tone subroutine to set the frequency of the tone output.

Line 420: Examines the Xth element in the A$(B) string. If it's a 1 then it passes the duration value for a dash to the tone subroutine and calls it. This causes a dash to be sent.

Line 430: If, in the preceding statement, the element in the string was a 0 then this line passes the duration value for a dot to the tone subroutine and calls it.

Line 440: Passes a frequency value of zero and the duration value for a dot to the tone subroutine to send an element space.

Lines 460-480: This loop sends the required number of elements to form the space between characters. Variable D2 determines how many elements will make up this space. The loop uses D2-1 because one element of space was already sent in line 440.

Line 490: Prints the character which corresponds to the code that was just sent.

The Tone Subroutine

The tone subroutine is written in 6502 machine language and poked into memory by lines 10, 20 and 30. It is a slightly modified version of the Simple Tone subroutine found in the Apple Reference Manual. To use this routine you must first provide it with frequency and duration information. This information is passed to the tone routine by two POKEs. The frequency value can range from 0 to 255 and is poked to memory address 0. The duration value, also 0 to 255, is poked to address 1. Once this is done the routine is called at address 16346 and the tone is produced. The tone subroutine is shown disassembled in Listing 2.

The Calibrate Routine

I've included the calibrate routine with the program so that the end user can fine-tune the preset code speeds to be as accurate as possible on his

A$(B)	Code data array.
B	Points to the character to be sent and printed.
CR$(B)	Character data entry.
D	Duration value address
D0	Duration value for a dot.
D1	Duration value for a dash.
D2	Number of elements per character space.
F	Frequency value address.
F0	Frequency value for no tone output.
F1	Frequency value for tone.
RP	Number of times to repeat a character.
TN	Tone subroutine address.

Table 1. Code generation routine variables.

```
3FDA  A5  00     LDA  $00
3FDC  F0  03     BEQ  $3FE1
3FDE  AD  30 C0  LDA  $C030
3FE1  88         DEY
3FE2  D0  04     BNE  $3FE8
3FE4  C6  01     DEC  $01
3FE6  F0  08     BEQ  $3FF0
3FE8  CA         DEX
3FE9  D0  F6     BNE  $3FE1
3FEB  A6  00     LDX  $00
3FED  4C  DA 3F  JMP  $3FDA
3FF0  60         RTS
```

Listing 2. Tone subroutine.

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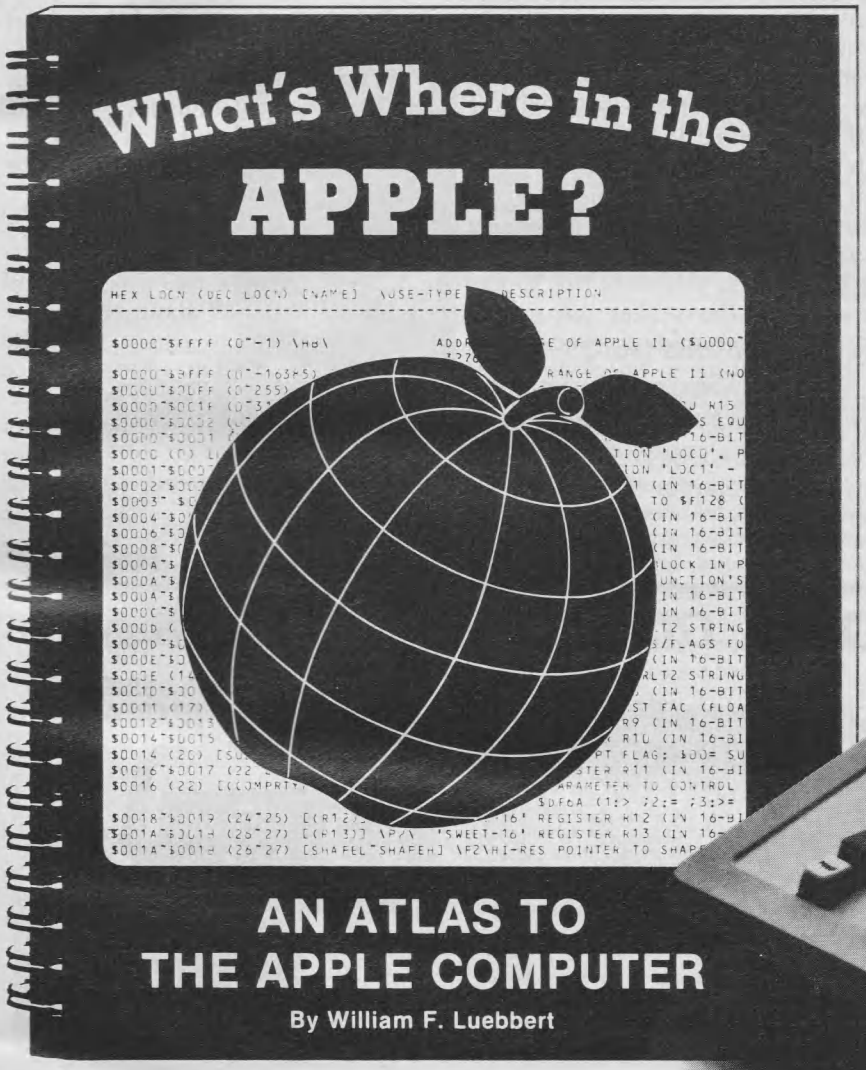
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own machine. To use this routine, run the main program and set the desired code speed. When the speed is set, exit the program with a control-C and pick up your stopwatch.

Type GOTO 1000 and start timing at the same time you hit return. A continuous series of dots will be sent, and the screen will start to fill up with numbers as the dots are counted. As soon as 30 seconds have elapsed, hit control-C to stop. Find how many dots were counted and multiply by two. Divide this by 25 to find the code speed in words per minute.

If the screen fills completely before 30 seconds elapse, use a timing interval of 15 seconds. This is because when the screen starts to scroll it slows down the timing loop and upsets the accuracy. Of course, when using 15 seconds you must multiply the number of dots by four before dividing by 25.

If the measured code speed does not come close to the selected code speed, then the value of variable D0 for that speed must be changed. The code speed values are found in lines 100 through 160. These lines assign values to D0 for code speeds from five to 35 words per minute. Finding the correct speed value for the desired code speed is a trial-and-error operation. Run the program again, and when asked for the code speed enter 0. This will put you into a mode that will accept speed values directly.

> Practice regularly,
> and above all
> do not use
> any visual aids.

Enter a value slightly higher or lower than the existing value for the code speed you want (the higher the number the slower the speed). Exit the program and execute the calibrate routine to check the code speed. Repeat this procedure until the code speed is as close as possible to what is desired. Enter this new speed value in the appropriate BASIC line (100-160) in place of the old value.

Using the Program

A practice session with the Code Teacher should consist of listening to the code and writing it down as you hear it. After a few sessions you will probably find that you can recognize certain characters immediately. However, other characters will cause you to hesitate before writing them down. Circle these characters for reference and concentrate on them later using the problem characters mode.

Last, the frequency of the tone can be varied by adjusting paddle 0. I added this feature after I got tired of listening to the same tone over and over.

Conclusion

With the help of this program and the investment of some time, you should be able to easily pass the Morse code portion of the novice exam. Just remember: practice regularly, and above all do not use any visual aids. The Morse code should be learned by sound, not by sight. ■

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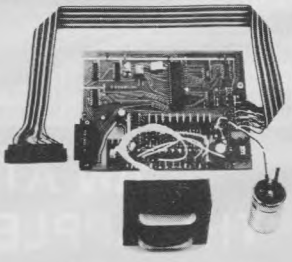
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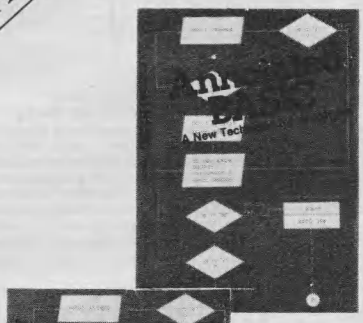
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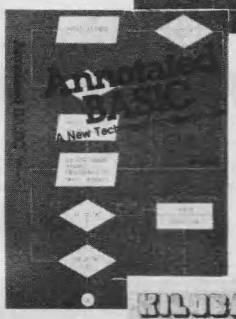
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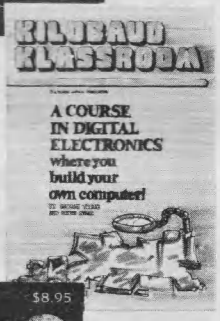
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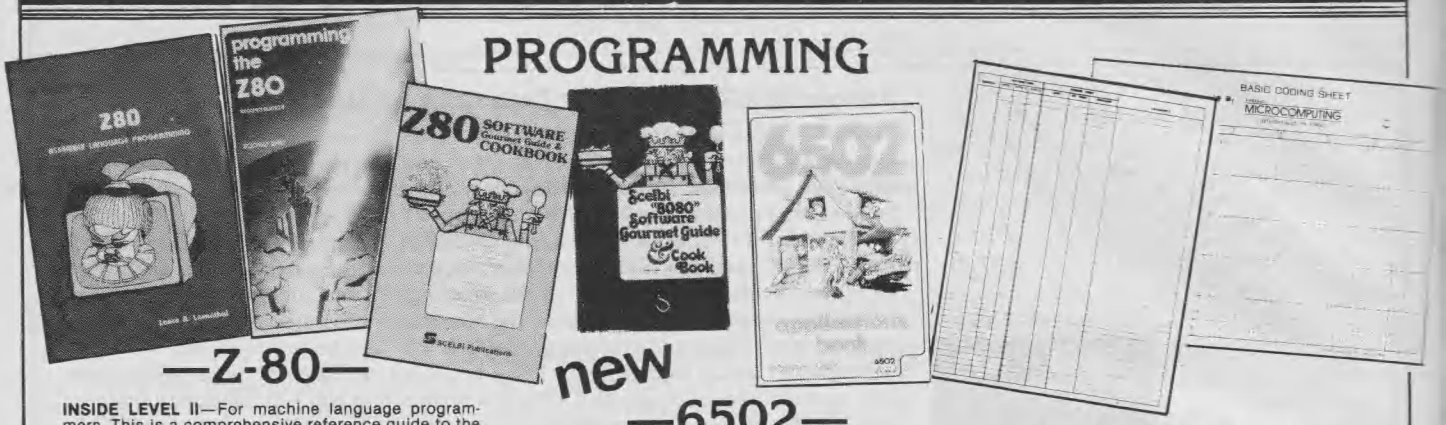
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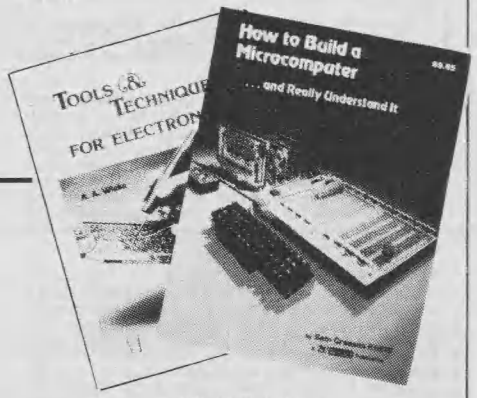
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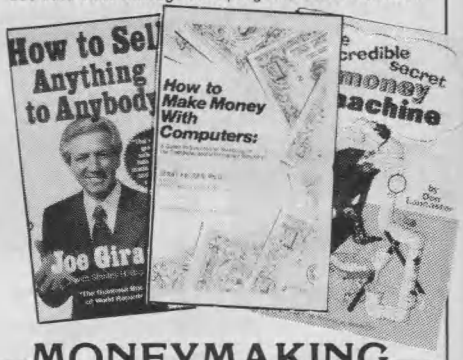
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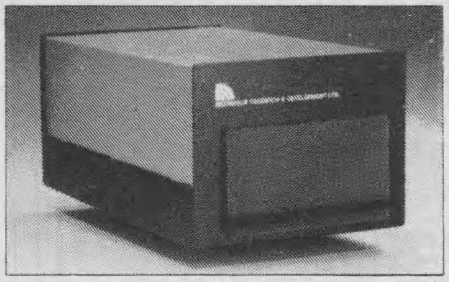
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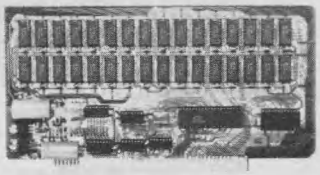
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four	thirty	cent	error	kilo	on	space	f w
five	forty	400hertz tone	feet	left	out	speed	g x
six	fifty	80hertz tone	flow	less	over	star	h y
seven	sixty	20ms silence	fuel	lesser	parenthesis	start	i z
eight	seventy	40ms silence	gallon	limit	percent	stop	j
nine	eighty	80ms silence	go	low	please	than	k
ten	ninety	160ms silence	gram	lower	plus	the	l
eleven	hundred	320ms silence	great	mark	point	time	m
twelve	thousand	centi	greater	meter	pound	try	n
thirteen	million	check	have	mile	pulse	up	o
fourteen	zero	comma	high	milli	rate	volt	p
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seventeen	and	degree	in	near	right	b	s

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alert	crease	fourth	more	receive	test
all	"de"	forward	move	record	"th"
ask	deposit	from	next	reverse	thank
assistance	dial	gas	no	red	third
attention	door	get	normal	repair	this
blue	east	going	north	repeat	turn
brake	"ed"	green	not	replace	under
button	emergency	hale	notice	room	use
buy	enter	heat	open	safe	waiting
call	entry	hello	operator	second	warning
called	"er"	help	or	secure	was
caution	"eth"	hurts	pass	select	water
celsius	evacuate	hold	per	send	west
centigrade	exit	hot	power	service	wind
change	fail	in	press	side	window
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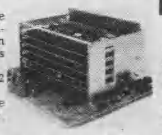
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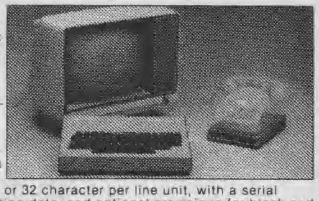
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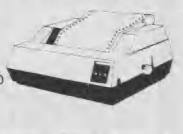
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	Soft Sector (512 B/S, 15 Sectors)	3114	3.09	473472	54479	800818	1669044	–	–	743-0/512	–	15100	DD34-4015	F145111X	425612
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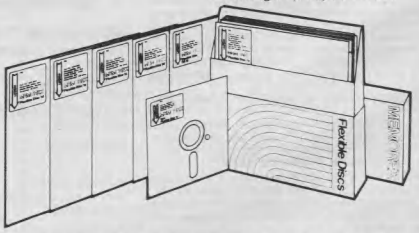
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74LS08	.35	74LS95	.85	74LS181	2.15	74LS364	1.95
74LS10	.25	74LS96	.95	74LS189	9.95	74LS365	.95
74LS11	.35	74LS107	.40	74LS190	1.00	74LS366	.95
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74LS63	1.25	74LS158	.75	74LS266	.55	74LS685	2.40
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74C10	.35	74C905	10.95	4023	.35	14411	11.95
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7413	.35	7483	.50	74155	.75	74247	1.25
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7425	.29	7494	.65	74164	.85	74279	.75
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AIM-65—Allows the user to save and load object code thru the AIM Monitor; to load, save, and append Text thru the AIM Editor; to load, save, and append Basic Programs thru the BASIC INTERPRETER; to assemble directly from disk single or multiple file programs.

SYM-1—Allows the user to save and load Files for use with the SYM Monitor, SYM Basic, and RAE-1.

ADDITIONAL COMMANDS:

ACTIVATE A DELETED FILE
COMPRESS A DISK
RENAME A DISK FILE
COPY A DISK
FORMAT A DISK
DELETE A DISK FILE
INITIALIZE A DISK
LIST CATALOG

SPECIFICATIONS:

- Completely assembled, tested, and burned in.
- Occupies address 8000-8FFF for AIM-65, $9000-9FFF for SYM-1, or $E000-EFFF for KIM-1.
- IBM Format; Single Density (128 bytes/sector); Dual Density (256,512, or 1024 bytes/sector).
- All ICs are in sockets.
- Fully buffered address and data bus.
- Standard KIM-4* BUS (both electrical pin-out and card size).
- Designed for use with a regulated power supply, but has provisions for adding regulators for use with an unregulated power supply.
- Dimensions: Board—10″ wide x 7″ high (including card-edge). Cabinet—9.25″ wide x 10″ high x 16″ deep.
- Power Requirements: +5v DC @ 2 Amps.
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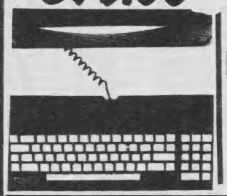


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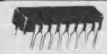
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74S10	.45	74S138	1.35	74S280	2.95
74S11	.45	74S139	1.35	74S287	3.25
74S15	.45	74S140	.79	74S288	2.75
74S20	.45	74S151	1.35	74S373	3.49
74S22	.45	74S153	1.35	74S374	3.49
74S30	.45	74S157	1.35	74S387	2.95
74S32	.55	74S158	1.35	74S471	10.95
74S38	1.25	74S160	2.95	74S472	10.95
74S40	.50	74S174	1.59	74S473	10.95
74S51	.45	74S175	1.59	74S474	12.95
74S64	.50	74S188	2.95	74S475	12.95
74S65	.50	74S194	1.95	74S570	5.95
74S74	.75	74S195	1.9[illegible]	74S571	5.95
74S86	.79	74S196	1.95	74S572	9.95
74S112	.79	74S240	2.95	74S573	9.95
74S113	.79	74S241	2.95	74S940	3.15
74S114	.79	74S242	3.25	74S941	3.15

CA–LINEAR

CA3010H	.99			CA3089N	3.75
CA3013H	2.15	CA3060N	3.25	CA3096N	3.95
CA3023H	3.25	CA3080H	1.25	CA3130H	1.39
CA3035H	2.49	CA3081N	2.00	CA3140H	1.25
CA3039H	1.35	CA3082N	2.00	CA3160H	1.25
CA3046N	1.30	CA3083N	1.60	CA3401N	.59
CA3059N	3.25	CA3086N	.85	CA3600N	3.50

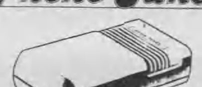
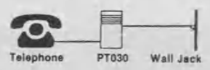
CD–CMOS

CD4000	.39			CD 4098	2.49
CD4001	.39			CD4506	.75
CD4002	.39			CD4507	.99
CD4006	1.19	CD4041	1.49	CD4508	3.95
CD4007	.25	CD4042	.99	CD4510	1.39
CD4009	.49	CD4043	.89	CD4511	1.29
CD4010	.49	CD4044	.89	CD4512	1.49
CD4011	.39	CD4046	1.79	CD4514	3.95
CD4012	.25	CD4047	2.50	CD4515	2.95
CD4013	.49	CD4048	1.35	CD4516	1.49
CD4014	1.39	CD4049	.49	CD4518	1.79
CD4015	1.19	CD4050	.69	CD4519	.89
CD4016	.59	CD4051	1.19	CD4520	1.29
CD4017	1.19	CD4052	1.19	CD4526	1.79
CD4018	.99	CD4053	1.19	CD4528	1.79
CD4019	.49	CD4056	2.95	CD4529	1.95
CD4020	1.19	CD4059	9.95	CD4543	2.79
CD4021	1.39	CD4060	1.49	CD4562	11.95
CD4022	1.19	CD4066	.79	CD4566	2.79
CD4023	.29	CD4068	.39	CD4583	2.49
CD4024	.79	CD4069	.45	CD4584	.75
CD4025	.23	CD4070	.55	CD4723	1.95
CD4026	2.95	CD4071	.49	CD4724	1.95
CD4027	.69	CD4072	.49	MC14409	17.95
CD4028	.89	CD4073	.39	MC14410	18.95
CD4029	1.49	CD4075	.39	MC14411	15.95
CD4030	.49	CD4076	1.39	MC14412	15.95
CD4034	3.49	CD4078	.55	MC14419	7.95
CD4035	.99	CD4081	.39	MC14433	15.95
CD4040	1.49	CD4082	.39	MC14538	2.49
		CD4093	.99	MC14541	1.95

Phone Tunes

As Seen on "Good Morning America"

Replaces the Telephone Ringer Bell with a Selection of 30 Familiar Tunes

Each Unit will play any of the following tunes:

- Rule Brittania
- O Canada
- Colonel Bogey
- Westminister Chimes
- Mexican Hat Dance
- Twinkle, Twinkle Little Star
- Deutschlandlied
- God Save the Queen
- Close Encounters
- Happy Birthday
- Wedding March
- Jingle Bells
- Auld Lang Syne
- Soldiers Chorus
- Sailor's Hornpipe
- Charge!
- Greensleeves
- Lorelei
- Eyes of Texas
- Star Spangled Banner
- Oranges and Lemons
- Wilhelmus
- Mozart Sonata
- Pomp & Circumstance
- William Tell Overture
- Bach Toccata in D Minor
- Shave and a Haircut
- Blue Danube Waltz
- Beethoven's 5th
- La Marseillaise

FEATURES

Replaces monotonous telephone ringer bell. Easily connects to any standard telephone. Can be used alongside regular phone or replace a remote ringer elsewhere in building or outside. FCC approved. Can be used on any telephone system — worldwide. Use a different tune to identify extension phones. Microprocessor controlled. Adjustable volume control and variable tune speed control. Operates on two 9-volt batteries or AC Adapter (not included).

PT030 Phone Tunes $49.95
AD30 AC Adapter $8.95

DISCRETE LEDS

XC556R	.200" red	5/$1	MV50	.085" red	6/$1
XC556G	.200" green	4/$1	XC209R	.125" red	5/$1
XC556Y	.200" yellow	4/$1	XC209G	.125" green	4/$1
XC556C	.200" clear	4/$1	XC209Y	.125" yellow	4/$1
XC22R	.200" red	5/$1	XC526R	.185" red	5/$1
XC22G	.200" green	4/$1	XC526G	.185" green	4/$1
XC22Y	.200" yellow	4/$1	XC526Y	.185" yellow	4/$1
MV10B	.170" red	4/$1	XC526C	.185" clear	4/$1

.200(T1¾) Red/Green

Diffused Bi-Color LED

Part No.	1-99	100+
XC5491	.79	.69

XC556 RED LED, METAL MTG. HDW. 2-6" LEADS.

RL-2 . . $.39 ea. or 3/$1.00

DISPLAY LEDS

C.A. — Common Anode
D.D. — Double Digit
C.C. — Common Cathode
RHD — Right Hand Decimal

Type	Polarity	Ht	Price
MAN 1	C.A.—red	.270	2.95
MAN 2	5x7 D.M.—red	.300	4.95
MAN 3	C.C.—red	.125	.25
MAN 52	C.A.—green	.300	.99
MAN 54	C.C.—green	.300	.99
MAN 71	C.A.—red	.300	.75
MAN 72	C.A.—red	.300	.75
MAN 74	C.C.—red	.300	1.25
MAN 82	C.A.—yellow	.300	.49
MAN 84	C.C.—yellow	.300	.99
MAN 3620	C.A.—orange	.300	.49
MAN 3630	C.A.—orange ± 1	.300	.99
MAN 3640	C.C.—orange	.300	.99
MAN 4610	C.A.—orange	.400	.99
MAN 6610	C.A.—orange—DD	.560	.99
MAN 6630	C.A.—orange ± 1	.560	.99
MAN 6640	C.C.—orange—DD	.560	.99
MAN 6650	C.C.—orange ± 1	.560	.99
MAN 6660	C.A.—orange	.560	.99
MAN 6710	C.A.—red—DD	.560	.99
MAN 6740	C.C.—red—DD	.560	.99
MAN 6750	C.C.—red ± 1	.560	.99
DLO304	C.C.—orange	.300	1.25
DLO307	C.A.—orange	.300	1.25
DLG500	C.C.—green	.500	1.25
DLG507	C.A.—green	.500	1.25
DL704	C.C.—red	.300	1.25
DL707	C.A.—red	.300	1.25
DL728	C.C.—red	.500	1.49
DL741	C.A.—red	.600	1.25
DL747	C.A.—red	.600	1.49
DL750	C.C.—red	.600	1.49
DLO847	C.A.—orange	.800	1.49
DLO850	C.C.—orange	.800	1.49
DL33B	C.C.—red	.110	.35
FND358	C.C. ± 1	.357	.99
FND357	C.C.	.357	.75
FND500	C.C. (FND503)	.500	.99
FND507	C.A. (FND510)	.500	.99
HDSP-3401	C.A.—red	.800	1.50
HDSP-3403	C.C.—red	.800	1.50
HDSP-3406	C.C. red ±1	.800	1.50
5082-7751	C.A., R.H.D.—red	.430	1.25
5082-7760	C.C., R.H.D.—red	.430	1.25
5082-7300	4x7 Numeric (RHD)	.600	22.00
5082-7302	4x7 Numeric (LHD)	.600	22.00
5082-7340	4x7 Hxdcl. (0-9/A-F)	.600	22.50
4N28	Photo Xsistor Opto-Isol.		.69
LIT-1	Photo Xsistor Opto-Isol.		.69
MOC3010	Optically Isol. Triac Driver		1.25

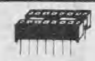
COMPUTER GRADE CAPACITORS



MFD	WVDC	PRICE	MFD	WVDC	PRICE	MFD	WVDC	PRICE
250	150	1.95	10,000	15	2.95	24,000	20	2.95
500	200	2.49	10,000	16	3.95	27,000	10	2.95
1,250	3	.99	11,000	19	4.95	32,500	25	4.95
1,500	25	1.95	11,000	55	5.49	40,000	25	5.95
1,500	50	2.95	11,000	60	5.95	43,000	10	5.95
2,000	10	2.95	13,000	16	2.95	50,000	20	7.95
2,250	100	3.95	14,000	13	2.95	52,000	20	5.95
2,300	33	2.95	14,000	35	3.95	55,000	15	5.95
2,500	15	2.95	18,000	10	3.95	58,000	20	5.95
3,000	25	1.95	20,000	20	2.95	65,000	10	7.95
3,600	40	3.95	20,000	55	3.95	73,800	5	7.95
4,500	50	3.95	21,000	15	3.95	80,000	15	9.95
5,500	25	4.49	23,000	7	1.95	90,000	10	8.95
6,100	40	2.49	23,000	10	2.95	160,000	10	8.95
6,600	50	4.95	23,000	20	3.95	200,000	3	12.95

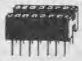
OVER 200 OTHER VALUES AVAILABLE — CALL OR WRITE FOR YOUR REQUIREMENT

LOW PROFILE (TIN) SOCKETS



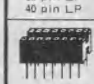
	1-24	25-49	50-100
8 pin LP	.17	.16	.15
14 pin LP	.20	.19	.18
16 pin LP	.22	.21	.20
18 pin LP	.29	.28	.27
20 pin LP	.34	.32	.30
22 pin LP	.37	.36	.35
24 pin LP	.38	.37	.36
28 pin LP	.45	.44	.43
36 pin LP	.60	.59	.58
40 pin LP	.63	.62	.61

SOLDERTAIL STANDARD (TIN)



	1-24	25-49	50-100
14 pin ST	.27	.25	.24
16 pin ST	.30	.27	.25
18 pin ST	.35	.32	.30
24 pin ST	.49	.45	.42
28 pin ST	.99	.90	.81
36 pin ST	1.39	1.26	1.15
40 pin ST	1.59	1.45	1.30

SOLDERTAIL (GOLD) STANDARD



	1-24	25-49	50-100
8 pin SG	.39	.35	.31
14 pin SG	.49	.45	.41
16 pin SG	.54	.49	.44
18 pin SG	.59	.53	.48
24 pin SG	.79	.75	.69
28 pin SG	1.10	1.00	.90
36 pin SG	1.65	1.40	1.26
40 pin SG	1.75	1.59	1.45

WIRE WRAP SOCKETS (GOLD) LEVEL #3



	1-24	25-49	50-100
8 pin WW	.59	.54	.49
10 pin WW	.69	.63	.58
14 pin WW	.79	.73	.67
16 pin WW	.85	.77	.70
18 pin WW	.99	.90	.81
20 pin WW	1.19	1.08	.99
22 pin WW	1.49	1.35	1.23
24 pin WW	1.39	1.26	1.14
28 pin WW	1.69	1.53	1.38
36 pin WW	2.19	1.99	1.79
40 pin WW	2.29	2.09	1.89

1/4 WATT RESISTOR ASSORTMENTS – 5%

		Values		
ASST. 1	5ea.	10 Ohm 12 Ohm 15 Ohm 18 Ohm 22 Ohm 27 Ohm 33 Ohm 39 Ohm 47 Ohm 56 Ohm	50pcs.	$1.95
ASST. 2	5ea.	68 Ohm 82 Ohm 100 Ohm 120 Ohm 150 Ohm 180 Ohm 220 Ohm 270 Ohm 330 Ohm 390 Ohm	50pcs.	$1.95
ASST. 3	5ea.	470 Ohm 560 Ohm 680 Ohm 820 Ohm 1K 1.2K 1.5K 1.8K 2.2K 2.7K	50pcs.	$1.95
ASST. 4	5ea.	3.3K 3.9K 4.7K 5.6K 6.8K 8.2K 10K 12K 15K 18K	50pcs.	$1.95
ASST. 5	5ea.	22K 27K 33K 39K 47K 56K 68K 82K 100K 120K	50pcs.	$1.95
ASST. 6	5ea.	150K 180K 220K 270K 330K 390K 470K 560K 680K 820K	50pcs.	$1.95
ASST. 7	5ea.	1M 1.2M 1.5M 1.8M 2.2M 2.7M 3.3M 3.9M 4.7M 5.6M	50pcs.	$1.95
ASST. 8R		Includes Resistor Assts. 1-7 (350 pcs.)		$10.95 ea.

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INTERSIL

Part No.	Function	Price
7045IPI	CMOS Precision Timer	14.95
7045EV/Kit*	Stopwatch Chip, XTL	24.95
7106CPL	3½ Digit A/D (LCD Drive)	16.95
7106EV/Kit*	IC, Circuit Board, Display	34.95
7107CPL	3½ Digit A/D (LED Drive)	15.95
7107EV/Kit*	IC, Circuit Board, Display	29.95
7116CPL	3½ Digit A/D LCD Dis. HLD.	18.95
7117CPL	3½ Digit A/D LED Dis. HLD.	17.95
7201IDR	Low Battery Volt Indicator	2.25
7205IPG	CMOS LED Stopwatch/Timer	12.95
7205EV/Kit*	Stopwatch Chip, XTL	19.95
7206CJPE	Tone Generator	5.15
7206CEV/Kit*	Tone Generator Chip, XTL	12.95
7207AIPD	Oscillator Controller	6.50
7207AEV/Kit*	Freq. Counter Chip, XTL	13.95
7208IPI	Seven Decade Counter	17.95
7209IPA	Clock Generator	3.95
7215IPG	4 Func. CMOS Stopwatch CKT	13.95
7215EV/Kit*	4 Func. Stopwatch Chip, XTL	19.95
7216AIJI	8-Digit Univ. Counter C.A.	32.00
7216CIJI	8-Digit Freq. Counter C.A.	26.95
7216DIPI	8-Digit Freq. Counter C.C.	21.95
7217IJI	4-Digit LED Up/Down Counter	12.95
7218CIJI	8-Digit Univ. LED Drive	10.95
7224IPL	LCD 4½ Digit Up Counter DRI	11.25
7226AIJL	8-Digit Univ. Counter	31.95
7226AEV/Kit*	5 Function Counter Chip, XTL	74.95
7240IJE	CMOS Bin Prog. Timer/Counter	4.95
7242IJA	CMOS Divide-by-256 RC Timer	2.05
7250IJE	CMOS BCD Prog. Timer/Counter	6.00
7260IJE	CMOS BCD Prog. Timer/Counter	5.25
7555IPA	CMOS 555 Timer (8 pin)	1.45
7556IPD	CMOS 556 Timer (14 pin)	2.20
7611BCPA	CMOS Op Amp Comparator 5MV	2.25
7612BCPA	CMOS Op Amp Ext. Cmvr. 5MV	2.95
7621BCPA	CMOS Dual Op Amp Comp. 5MV	3.95
7631CCPE	CMOS Tri Op Amp Comp. 10MV	5.35
7641CCPD	CMOS Quad Op Amp Comp. 10MV	7.50
7642CCPD	CMOS Quad Op Amp Comp. 10MV	7.50
7660CPA	Voltage Converter	2.95
8038CCPD	Waveform Generator	4.95
8048CCPE	Monolithic Logarithmic Amp	21.60
8069CCQ	50ppm Band—GAP Volt Ref. Diode	2.50
8211CPA	Volt Ref/Indicator	2.95
8212CPA	Volt Ref/Indicator	2.95

74C

74C00	.39			74C221	1.95
74C02	.39	74C95	1.59	74C240	2.25
74C04	.39	74C107	1.89	74C244	2.25
74C08	.39	74C151	2.95	74C373	2.49
74C10	.39	74C154	3.95	74C374	2.59
74C14	.75	74C157	2.25	74C901	.69
74C20	.39	74C160	1.69	74C903	.69
74C30	.39	74C161	1.60	74C911	10.95
74C42	1.39	74C162	1.49	74C912	10.95
74C48	1.95	74C163	1.69	74C915	1.69
74C73	.79	74C164	1.59	74C917	10.95
74C74	.79	74C173	1.39	74C922	5.49
74C85	1.95	74C174	1.39	74C923	5.75
74C86	.99	74C175	1.19	74C925	7.50
74C89	6.95	74C192	1.69	74C926	7.50
74C90	1.29	74C193	1.69	80C95	.79
74C93	1.29	74C195	1.59	80C97	.79

LINEAR

LH0002CN	6.85			LM702H	.79
LM10CLH	4.50			LM703CN	.89
LM11CLH	4.75	LM340T-5	1.25	LM709N	.29
LH0070-OH	4.95	LM340T-12	1.25	LM710N	.79
TL071CP	.79	LM340T-15	1.25	LM711N	.79
TL072CP	1.39	LM341P-5	.75	LM723N	.69
TL074CN	2.49	LM341P-12	.75	LM733N	1.00
LH0082CD	35.80	LM341P-15	.75	LM739N	1.19
TL082CP	1.19	LM342P-5	.69	LM741CN	.35
TL084CN	2.19	LM342P-12	.69	MC1741SCG	3.00
LH0094CD	36.80	LM342P-15	.69	LM747N	.79
LM300H	.99	LM348N	1.25	LM748N	.59
LM301CN	.35	LM350K	5.75	LM1014N	2.75
LM302H	1.95	LF351N	.60	LM1310N	1.95
LM304H	1.95	LF353N	1.00	LM1458CN	.59
LM305H	.99	LF355N	1.10	LM1488N	1.25
LM307CN	.45	LF356N	1.10	LM1489N	1.25
LM308CN	1.00	LM358N	1.00	LM1496N	1.95
LM309H	1.95	LM359N	1.79	LM1556V	1.75
LM309K	1.25	LM370N	4.49	LM1800N	2.95
LM310CN	1.75	LM373N	3.25	LM1871N	5.49
LM311/CN	.90	LM377N	2.95	LM1872N	5.49
LM312H	2.49	LM380N	1.25	LM1877N-9	3.25
LM317MP	1.15	LM381N	1.95	LM1889N	3.20
LM317T	1.75	LM382N	1.79	LM1896N	1.75
LM317K	3.95	LM384N	1.95	LM2002T	1.49
LM318CN	1.95	LM386N-3	1.29	LM2877P	2.05
LM319N	1.95	LM387N	1.45	LM2878P	2.25
LM320K-5	1.35	LM389N	1.35	LM2896P-1	2.25
LM320K-12	1.35	LM392N	.69	LM3189N	2.95
LM320K-15	1.35	LF398N	4.00	LM3900N	.69
LM320T-5	1.25	LM399H	5.00	LM3905CN	1.25
LM320T-12	1.25	TL494CN	4.49	LM3909N	1.15
LM320T-15	1.25	TL496CP	1.75	LM3914N	3.95
LM323K	5.95	NE510A	6.00	LM3915N	3.95
LM324N	.99	NE529A	4.95	LM3916N	3.95
LM329DZ	.65	NE531H	3.95	RC4136N	1.25
LM331N	3.95	NE536H	6.00	RC4151NB	3.95
LM334Z	1.30	NE540H	6.00	RC4194TK	6.95
LM335Z	1.40	NE544N	4.95	RC4195TK	5.49
LM336Z	1.75	NE550A	1.30	LM4500A	3.25
LM337T	1.95	NE555V	.39	ICL8038B	4.95
LM337MP	1.15	LM556N	.99	LM13080N	1.29
LM338K	6.95	NE564N	3.95	LM13600N	1.49
LM339N	.99	LM565N	1.25	75138N	1.95
LM340K-5	1.35	LM566CN	1.95	75450N	.89
LM340K-12	1.35	LM567V	1.25	75451CN	.39
LM340K-15	1.35	NE570N	4.95	75492	.89

CAPACITOR CORNER

50 VOLT CERAMIC DISC CAPACITORS

Value	1-9	10-99	100+	Value	1-9	10-99	100+
10 pf	.08	.06	.05	.001µF	.08	.06	.05
22 pf	.08	.06	.05	.0047µF	.08	.06	.05
47 pf	.08	.06	.05	.01µF	.08	.06	.05
100 pf	.08	.06	.05	.022µF	.09	.07	.06
220 pf	.08	.06	.05	.047µF	.09	.07	.06
470 pf	.08	.06	.05	.1µF	.15	.12	.10

100 VOLT MYLAR FILM CAPACITORS

.001mf	.12	.10	.07	.022mf	.13	.11	.08
.0022mf	.12	.10	.07	.047mf	.21	.17	.13
.0047mf	.12	.10	.07	.1mf	.27	.23	.17
.01mf	.12	.10	.07	.22mf	.33	.27	.22

+20% DIPPED TANTALUMS (Solid) CAPACITORS

.1/35V	.39	.34	.29	1.5/35V	.41	.37	.29
.15/35V	.39	.34	.29	2.2/35V	.51	.45	.34
.22/35V	.39	.34	.29	3.3/25V	.53	.47	.37
.33/35V	.39	.34	.29	4.7/25V	.63	.56	.45
.47/35V	.39	.34	.29	6.8/25V	.79	.69	.55
.68/35V	.39	.34	.29	15/25V	1.39	1.25	.95
1.0/35V	.39	.34	.29	22/6V	.79	.69	.55

MINI. ALUMINUM ELECTROLYTIC CAPACITORS

Axial	1-99	100-499	500+	Radial	1-99	100-499	500+
.47/50V	.16	.14	.10	.47/25V	.15	.13	.12
1.0/50V	.19	.16	.12	.47/50V	.16	.14	.13
3.3/50V	.17	.15	.11	1.0/16V	.15	.13	.12
4.7/25V	.18	.15	.11	1.0/25V	.16	.14	.13
10/25V	.18	.15	.11	1.0/50V	.17	.15	.14
10/50V	.19	.16	.12	4.7/16V	.15	.13	.12
22/25V	.19	.16	.12	4.7/25V	.16	.14	.13
22/50V	.24	.20	.18	4.7/50V	.17	.15	.14
47/25V	.25	.21	.19	10/16V	.15	.13	.12
47/50V	.29	.25	.23	10/25V	.16	.14	.13
100/25V	.28	.24	.22	10/50V	.17	.15	.14
100/50V	.41	.37	.34	47/50V	.25	.21	.19
220/25V	.39	.34	.33	100/16V	.21	.17	.14
220/50V	.49	.45	.41	100/25V	.25	.23	.21
470/25V	.54	.49	.45	100/50V	.37	.34	.31
1000/16V	.79	.69	.61	220/16V	.25	.21	.19
2200/16V	.89	.79	.69	470/25V	.35	.31	.27

National Semiconductor Clock Modules

12VDC AUTOMOTIVE/ INSTRUMENT CLOCK



APPLICATIONS:
- In-dash autoclocks
- After-market auto/ RV clocks
- Aircraft-marine clks.
- 12VDC oper. instru.
- Portable/battery powered instrumnts.

Features: Bright 0.3" green display. Internal crystal time-base. ± 0.5 sec./day accur. Auto. display brightness control logic. Display color filterable to blue, blue-green, green & yellow. Complete – just add switches and lens.

MA1003 Module (3.05"Lx1.75"Hx.98"D) . **$16.95**

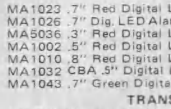
CLOCK MODULES

MA1023 .7" Red Digital LED Clock Module	8.95
MA1026 .7" Dig. LED Alarm Clock/Thermometer	18.95
MA5036 .3" Red Digital LED Clock/Timer	6.95
MA1002 .5" Red Digital LED Clock & Xformer	9.95
MA1010 .8" Red Digital LED Clock	7.95
MA1032 CBA .5" Digital LCD Clock	17.95
MA1043 .7" Green Digital LED Clock	8.95

TRANSFORMERS

102-P20 Xformer for MA1023, 1043 & 5036 Mods.	3.49
102-P22 Xformer for MA1026 Clock Modules	3.49
102-P24 Xformer for MA1010 Clock Modules	3.49

NEW! **Sun Power Your Electronics!**
SOLAR CELL PANEL KIT

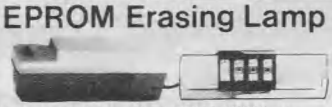


Features:
- Output: 10VDC, to 100mA in Series 5VDC, to 200mA in Parallel
- Panel may be easily connected for Series or Parallel out
- Over 11 square inches of active cell surface
- Voltage line tap @ 0.5V increments
- Provision for charging batteries
- Overall panel size: 4¼"L x 4½"H x ½"D

The JE305 Solar Cell Panel Kit contains 20 each solar cells. On the panel board are power line taps which allow the user to select voltages (one voltage at a time) from 0.5VDC to 10VDC. The applications of each panel can be further expanded by coupling additional panels in series for more voltage or in parallel for more current. The premium grade solar cells provide the current necessary for the operation of most portable transistor radios, small battery powered cassette tape players and unlimited experimental solar projects.

JE305 . . . . . **$39.95**

EPROM Erasing Lamp



- Erases 2708, 2716, 1702A, 5203Q, 5204Q, etc.
- Erases up to 4 chips within 20 minutes.
- Maintains constant exposure distance of one inch.
- Special conductive foam liner eliminates static build-up.
- Built-in safety lock to prevent UV exposure.
- Compact – only 7-5/8" x 2-7/8" x 2"
- Complete with holding tray for 4 chips.

UVS-11EL Replacement Bulb $16.95

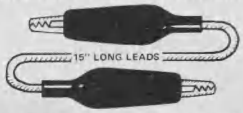
UVS-11E **$79.95**

JOYSTICKS



JS-5K	5K Linear Taper Pots	$5.25
JS-100K	100K Linear Taper Pots	$4.95
JVC-40	40K (2) Video Controller in case	$4.95

ALLIGATOR CLIP TEST LEADS

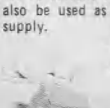


Heavy-duty leads, color coded. Insulated alligator clip on each end. 15" long. Two each black, red, blue, white and yellow.

#ALCP (10 per pack) . . . . . **$2.95/pkg.**

NEW! **JE215 Adjustable Dual Power Supply**

General Description: The JE215 is a Dual Power Supply with independent adjustable positive and negative output voltages. A separate adjustment for each of the supplies provides the user unlimited applications for IC current voltage requirements. The supply can also be used as a general all-purpose variable power supply.



FEATURES:
- Adjustable regulated power supplies, pos. and neg. 1.2VDC to 15VDC.
- Power Output (each supply): 5VDC @ 500mA, 10VDC @ 750mA, 12VDC @ 500mA, and 15VDC @ 175mA.
- Two, 3-terminal adj. IC regulators with thermal overload protection.
- Heat sink regulator cooling
- LED "on" indicator
- Printed Board Construction
- 120VAC input
- Size: 3 1/2"w x 5 1/16"L x 2"H

JE215 Adj. Dual Power Supply Kit (as shown) . . $24.95

(Picture not shown but similar in construction to above)

JE200 Reg. Power Supply Kit (5VDC, 1 amp) . .	$14.95
JE205 Adapter Brd. (to JE200) ±5, ±9 & ±12V.	$12.95
JE210 Var. Pwr. Sply. Kit, 5-15VDC, to 1.5amp.	$19.95

MICROPROCESSOR COMPONENTS

8080A/8080A SUPPORT DEVICES

INS8080A	CPU	4.95
DP8212	8-Bit Input/Output	3.25
DP8214	Priority Interrupt Control	5.95
DP8216	Bi-Directional Bus Driver	3.49
DP8224	Clock Generator/Driver	3.95
DP8226	Bus Driver	3.49
DP8228	System Controller/Bus Driver	4.95
DP8238	System Controller	5.95
INS8243	I/O Expander for 48 Series	9.95
INS8250	Asynchronous Comm. Element	16.95
DP8251	Prog. Comm. I/O (USART)	9.95
DP8253	Prog. Interval Timer	8.95
DP8255	Prog. Peripheral I/O (PPI)	5.95
DP8257	Prog. DMA Control	9.95
DP8259	Prog. Interrupt Control	9.95
DP8275	Prog. CRT Controller	39.95
DP8279	Prog. Keyboard/Display Interface	9.95
DP8303	System Timing Element	6.95
DP8304	8-Bit Bi-Directional Receiver	3.95
DP8307	8-Bit Bi-Directional Receiver	3.95
DP8308	8-Bit Bi-Directional Receiver	3.95
DP8310	Octal Latched Peripheral Driver	5.25
DP8311	Octal Latched Peripheral Driver	5.25

6800/6800 SUPPORT DEVICES

MC6800	MPU	7.95
MC6802CP	MPU with Clock and RAM	14.95
MC6810API	128x8 Static RAM	4.95
MC6821	Peripheral Inter. Adapt (MC6820)	7.49
MC6828	Priority Interrupt Controller	17.95
MC6830L8	1024x8 Bit ROM (MC68A30-8)	14.95
MC6850	Asynchronous Comm. Adapter	6.95
MC6852	Synchronous Serial Data Adapter	6.95
MC6860	0-600bps Digital MODEM	10.95
MC6861	2400bps Modulator	12.95
MC6880A	Quad 3-State Bus Trans. (MC8726)	2.25

MICROPROCESSOR CHIPS

Z80 (780C)	CPU (MK3880N) (2MHz)	11.95
Z80A (780-1)	CPU (MK3880N-4) (4MHz)	13.95
CDP1802	CPU	19.95
2650	MPU	16.95
IDM2901A	ADC CPU—4-Bit Slice (Com. Temp. Grade)	19.95
MC6809	MPU w/Clock (63K Bytes Memory)	11.95
INS8035N-6	MPU—8-Bit (6MHz)	7.95
INS8039N-6	CPU—Sgl. Chip 8-Bit (128 Bytes RAM)	9.95
INS8040N-6	CPU (256 Bytes RAM)	24.95
INS8070N	CPU—64 Bytes RAM	34.95
INS8073N	CPU w/Basic Micro Interpreter	29.95
P8085	CPU	9.95
TMS9900JL	MPU—16-Bit	39.95

SHIFT REGISTERS

MM500H	Dual 25-Bit Dynamic	.50
MM502H	Dual 50-Bit Dynamic	.50
MM506H	Dual 100-Bit Static	.50
MM510H	Dual 64-Bit Accumulator	.50
MM1402N	256-Bit Dynamic	2.95
MM5013N	1024-Bit Dynamic/Accumulator	1.95
MM5016H	500/512-Bit Dynamic	1.95
MM5034N	Octal 80-Bit	9.95
MM5035N	Octal 80-Bit	9.95
2504V (1404A)	1024-Bit Dynamic	1.95
2518N	Hex 32-Bit Static	3.95
2522V	Dual 132-Bit Static	2.95
2524V	512-Bit Dynamic	.99
2525V	1024-Bit Dynamic	2.95
2527V	Dual 256-Bit Static	2.95
2528V	Dual 250-Bit Static	4.00
2529V	Dual 360-Bit Static	4.00
2532N	Quad 80-Bit Static	2.95
3341PC	Fifo (Dual 80)	6.95

DATA ACQUISITION

AF100-1CN	Universal Active Filter 2.5%	5.95
AF121-1CJ	Touch Tone Low Band Filter	19.95
AF122-1CJ	Touch Tone High Band Filter	19.95
LM308CH	Super Gain Op Amp	1.15
LM334Z	Current Control Source	1.30
LM335Z	Temperature Transducer	1.40
LF356N	JFET Input Op Amp	1.10
LF398N	Sample & Hold Amplifiers	3.95
LM399H	Temp. Comp. Prec. Ref. (.5ppm/C°)	5.00
ADC0804LCN	8-Bit A/D Converter (1 LSB)	4.95
DAC0806LCN	8-Bit D/A Converter (0.78% Lin.)	2.25

DATA ACQUISITION (CONTINUED)

ADC0809CCN	8-Bit A/D Converter (8-Ch. Multi.)	5.25
ADC0811CCN	8-Bit A/D Converter (16-Ch. Multi.)	10.95
DAC1000LCN	10-Bit D/A Conv. Micro. Comp. (0.05%)	13.95
DAC1008LCN	10-Bit D/A Conv. Micro. Comp. (0.20%)	8.95
DAC1020LCN	10-Bit D/A Converter (0.05% Lin.)	8.49
DAC1021LCN	10-Bit D/A Converter (0.20% Lin.)	5.95
DAC1222LCN	12-Bit D/A Converter (0.20% Lin.)	9.95
CD4051N	8-Channel Multiplexer	1.19
AY-5-1013	30K BAUD UART	6.95

RAM'S

1101	256x1 Static	1.49
1103	1024x1 Dynamic	.99
2101 (8101)	256x4 Static	3.95
2102	1024x1 Static	1.75
2102L02	1024x1 Static	1.95
2111 (8111)	256x4 Static	3.95
2112	256x4 Static MOS	4.95
2114	1024x4 Static 450ns	3.25
2114L	1024x4 Static 450ns Low Power	3.49
2114-2	1024x4 Static 200ns	3.95
2114L-2	1024x4 Static 200ns Low Power	4.95
2147200	256x1 Static	8.95
4116N-4 (UPD416)	16K Dynamic 250ns (MMS290N-4)	2.95
4164N-3	64K Dynamic 200ns	19.95
MM2147J	4096x1 Fast 70ns	7.95
5101	256x4 Static	7.95
MMS261	1024x1 Dynamic Fully Decoded	.99
MMS262	2Kx1 Dynamic	.49
MMS280/2107	4096x1 Dynamic	4.95
MMS290N-2 (4116)	16K Dynamic 150ns (UPD416C-3)	3.95
MMS298J-3A	8K Dyn. 200ns (lower ½ of MMS298J)	3.95
HM6116-4	16K (2Kx8) Static 200ns	14.95
82S25	64 Bit RAM (16x40C)	3.49
UPD414/MK4027	4K Dynamic 16-pin	6.95
TMS4044-45YL	4K Static	9.95
TMS4045	1024x4 Static	9.95

PROMS/EPROMS

1702A	2K UV Erasable PROM	5.95
2708	8K EPROM	4.95
TMS2716	16K EPROM (+5V, +5V, +12V)	9.95
2716Intel(2516)TI	16K EPROM (Single +5V)	8.95
2732Intel TI	32K EPROM	17.95
2758	8K EPROM (450ns) (Single +5V)	7.49
2764Q	64K EPROM (Hitachi) HN462764)	49.95
5203	2048 PROM	14.95
82S23(74S188)	32x8 PROM (Open Collector)	3.95
82S115	4096 Bipolar PROM	14.95
82S123(74S288)	32x8 Tri-State Bipolar PROM	3.95
82S185	8K PROM	16.95

— Over 30 More PROMS Listed in Our Catalog —

ROM'S

2513(2140)	Character Generator (Upper Case)	9.95
2513(3021)	Character Generator (Lower Case)	9.95

NMOS READ ONLY MEMORIES

MCM66710P	128x9x7 ASCII Shifted w/Greek	13.50
MCM66740P	128x9x7 Math Symbol & Pictures	13.50
MCM66750P	128x9x7 Alpha, Control Char. Gen.	13.50

MICROPROCESSOR MANUALS

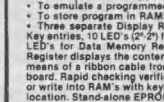
M-Z80	User Manual	7.50
M-CDP1802	User Manual	7.50
M-2650	User Manual	5.00

SPECIAL FUNCTION

DS0025CN	Dual MOS Clock Driver (SMZ)	3.50
DS0026CN	Dual MOS Clock Driver (SMZ)	1.95
INS1771N-1	Floppy Disc Controller	24.95
INS2651N	Communication Chip	19.95
MM5841N	Microprocessor Real Time Clock	8.95
MM58174N	Microprocessor Compatible Clock	11.95
COP402N	Microcontroller with 64-Digit RAM and Direct LED Drive	6.95
COP402MN	Microcontroller with 64-Digit RAM & Direct LED Drive w/N Buss Int.	7.49
COP470N	32-Seg. VAC Fluor. Driver (20-pin pkg.)	3.25

TELEPHONE/KEYBOARD CHIPS

AY-5-9100	Push Button Telephone Dialer	14.95
AY-5-9200	Repertory Dialer	14.95
AY-5-9500	CMOS Clock Generator	4.95
AY-5-2376	Keyboard Encoder (86 keys)	11.95
HD0165-5	Keyboard Encoder (16 keys)	7.95
74C922	Keyboard Encoder (16 keys)	5.49
74C923	Keyboard Encoder (20 keys)	5.75
MMS3190N	Push Button Pulse Dialer	7.95
MMS7499N	96/144-Key Serial Keyboard Encoder	8.95



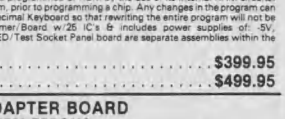
2400-10

EECO Rocker DIP Switch — "Mini-Dip™" 2400 Series
THE MOST UNIQUE DIP SWITCH AVAILABLE!

MINI-DIP is designed to retrofit all major brands of Dip switches. Unique features include locking rod design to prevent accidental actuation and gold self-wiping contact. One-piece housing and press-fit terminals prevent contamination. 2-10 station Form "A" and 1-5 station Form "C".
• Terminals on .100 x .300 (2.54 x 7.62) centers • PCB or dip socket mountable • Positive cleaning/wiping action with gold contact • Total seal and bottom seal

Part No.	Pos.	Configuration	Socket	Price	Part No.	Pos.	Configuration	Socket	Price
2400-2	2	12	8 pin	.79 - 10/ 6.95	2400-6	6	123456	14 pin	1.09 - 10/ 9.95
2400-3	3	123	8 pin	.89 - 10/ 7.95	2400-7	7	1234567	14 pin	1.19 - 10/10.95
2400-4	4	1234	8 pin	.99 - 10/ 8.95	2400-8	8	12345678	16 pin	1.29 - 10/11.95
2400-ABCD	4	ABCD	8 pin	.99 - 10/ 8.95	2400-9	9	123456789	18 pin	1.39 - 10/12.95
2400-5C	6	C54321	14 pin	1.09 - 10/ 9.95	2400-10	10	0123456789	20 pin	1.49 - 10/13.95

JE608 PROGRAMMER
2704/2708 EPROM PROGRAMMER



GENERAL APPLICATIONS:
- To program EPROMS 2704 and 2708.
- Developmental system for microcomputer circuits
- To read the contents of a pre-programmed EPROM
- To compare EPROM(s) for content differences
- To emulate a programmed EPROM
- To store program in RAMS for alterations
- Three separate Display Registers: 8 LED's for Hex Key entries, 10 LED's (2^20) for Address Register and 8 LED's for Data Memory Register. The Data Memory Register displays the content of the RAMs from the EPROM Chip. Development of microprocessor systems by means of a ribbon cable from the programmer panel test socket to the EPROM socket on the microprocessor board. Rapid checking verification of programmed data changes. User may move data from a master to RAM's or write into RAM's with keyboard entries. Allows manual stepping manipulation (up and down) at any address location. Stand-alone EPROM Programmer consisting of: A 19-key Hexadecimal Keyboard assembly, Programmer Board assembly with 4 power supplies and a LED/Test Socket Panel Board assembly. The Test Socket is zero force insertion type. Power requirements: 115VAC, 80Hz, 6W. Compact desk-top enclosure: Color-coordinated designer's case with light tan panels and molded end pieces in mocha brown. Size: 3¼"H x 11"W x 8¼"D. Weight: 5 lbs.

The JE608 EPROM Programmer is a completely self-contained unit which is independent of computer control and requires no additional systems for its operations. The EPROM can be programmed from the Hexadecimal Keyboard or from a pre-programmed EPROM. The JE608 Programmer can emulate a programmed EPROM by the use of its internal RAM circuits. This will allow the user to test or pretest a program for a system, prior to programming a chip. Any changes in the program can be entered directly into the memory circuits with the Hexadecimal Keyboard so that rewriting the entire program will not be necessary. The JE608 Programmer contains a Programmer/Board w/25 IC's & includes power supplies of: -5V, +5V, +12V and +26V. The Hexadecimal Keyboard and LED/Test Socket Panel board are separate assemblies within the system.

JE608K Kit **$399.95**

JE608A Assembled and Tested **$499.95**

JE608-16K ADAPTER BOARD
FOR 2716/2758 EPROMS

GENERAL DESCRIPTION:
The JE608-16K Adapter Board allows the JE608 Programmer to be modified for the additional programming of the 2716 and 2758 EPROMS. The adapter provides for adding an address switch for the 2^11 bit and also for selecting the proper power and timing pulses to be applied to the EPROM. Programming and emulating the 2716 (16K) EPROM is done separately to each half (1024x8) of the EPROM because of the existing 8K RAM capacity in the JE608 Programmer.

JE608-16K	Adapter Board Kit	**$29.95**
JE608-Upgrade	(Send assembled JE608 to factory for adapter installation of the JE608-16K Adapter Board Kit)	**$99.95**
JE608A-16K Mod.	Assembled JE608 w/Adapter (JE608-16K) Installed	**$599.95**

$10.00 Min. Order – U.S. Funds Only
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Postage—Add 5% plus $1.50 Insurance

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BOOKS
National Semiconductor — Intersil — Intel

30001	**National CMOS Data Book** (640 pages) 74C, CD4000, and A/D Converters	$5.95
30002	**National Interface Data Book** (704 pages) DP, DS8000, DS3600, DS7500, etc.	$5.95
30003	**National Linear Data Book** (1376 pages) LM, LF, ADC, DAC, LH Series	$8.95
30004	**National Series 80 — Board Level Computer** (224 pages)	$4.95
30005	**National TTL Logic Data Book** (624 pages) 7400, LS, L, H, S, and DM8000 Series	$8.95
30006	**Buy above (3) 30001,3,5 as a set**	$19.95/lot
30009	**Intersil Data Book** (1074 pages)	$6.95
010400	**Intel Component Data Catalog** Full data sheets for Intel's products incl. memory devices, microproc., peripherals & indust./mil. products (1326 pages)	$10.00
205610	**Intel Peripheral Design Handbook** Full data sheets, appl. notes for Intel peripheral device components (644 pages)	$7.50

AC and DC Wall Transformers



With Universal Plug and 9V Battery Snap

Selective voltages: 6,9,12VDC. Polarity selection (+/-). six-foot line from adapter to plugs — six-inch line from adapter to battery snap. 120V/60Hz. 300mA.

Part No.	Input	Output	Price
AC 250	117V/60Hz	12VAC 250mA	$3.95
AC 500	117V/60Hz	12VAC 500mA	$4.95
AC1000	117V/60Hz	12VAC 1 amp	$5.95
AC1700	117V/60Hz	9VAC 1.7 amp	$3.95
DC6912	120V/60Hz	6,9,12VDC 300mA	$9.95
DV9200	117V/60Hz	9VDC 200mA	$3.25
DC900	120V/60Hz	9VDC 500mA	$3.95

CONNECTORS



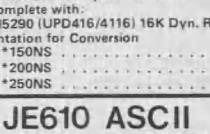
DB25P	D-Subminiature Plug	$2.95
DB25S	D-Subminiature Socket	$3.50
D20418-2	Screw Lock Hdwr. (2) DB25S/P	2/$.99
DB51226	Cover for DB25P/S	$1.75
22/44SE	P.C. Edge (22/44 Pin)	$2.95
UG88/U	BNC Plug	$1.79
UG89/U	BNC Jack	$3.79
UG175/U	UHF Adapter	$ .49
SO239	UHF Panel Recp.	$1.29
PL258	UHF Adapter	$1.60
PL259	UHF Plug	$1.60
UG260/U	BNC Plug	$1.79
UG1094/U	BNC Bulkhead Recp.	$1.29

TRS-80 16K Conversion Kit

Expand your 4K TRS-80 System to 16K.
Kit comes complete with:
- ★ 8 ea. MM5290 (UPD416/4116) 16K Dyn. Rams (*NS)
- ★ Documentation for Conversion

TRS-16K2 *150NS	$29.95
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JE610 ASCII Encoded Keyboard Kit



The JE610 ASCII Keyboard Kit can be interfaced into most any computer system. The kit comes complete with an industrial grade keyboard switch assembly (62-keys), IC's, sockets, connector, electronic components and a double-sided printed wiring board. The keyboard assembly requires +5V @ 150mA and –12V @ 10 mA for operation. Features: 60 keys generate the 126 characters, upper and lower case ASCII set. Fully buffered. Two user-define keys provided for custom applications. Caps lock for upper-case-only alpha characters. Utilizes a 2376 (40-pin) encoder read-only memory chip. Outputs directly compatible with TTL/DTL or MOS logic arrays. Easy interfacing with a 16-pin dip or 18-pin edge connector. Size: 3¼"H x 14½"W x 8¾"D

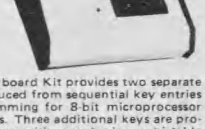
JE610/DTE-AK (After assembled as pictured above) . . . **$124.95**

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The JE600 Encoder Keyboard Kit provides two separate hexadecimal digits produced from sequential key entries to allow direct programming for 8-bit microprocessor or 8-bit memory circuits. Three additional keys are provided for user operations with one having a bistable output available. The outputs are latched and monitored with 9 LED readouts. Also included is a key entry strobe. Features: Full 8-bit latched output for microprocessor use. Three user-define keys with one being bistable operation. Debounce circuit provided for all 19 keys. 9 LED readouts to verify entries. Easy interfacing with standard 16-pin IC connector. Only +5VDC required for operation. Size: 3¼"H x 8¾"W x 8¾"D

JE600/DTE-HK (After assembled as pictured above) . . . **$99.95**

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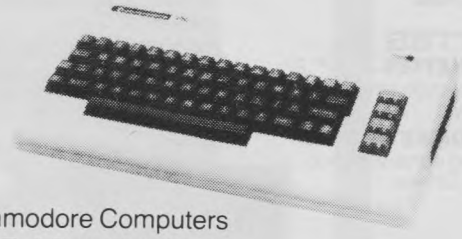
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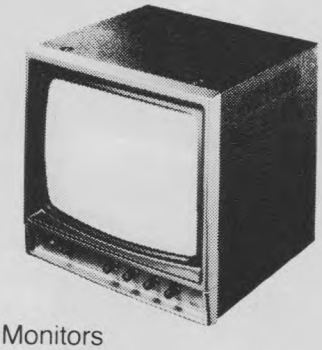
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74LS132N	.75	**A to D CONVERTER**		74C160	1.69	Z80 DART	15.25	3.2768 MHz	4.50
74LS136N	.49	8038B	4.50	74C175	1.19	Z80A DART	18.75	5.0688 MHz	4.50
74LS151N	.75	8709CJ	13.95	74C192	1.65	Z80 DMA	17.50	5.185 MHz	4.50
74LS155N	.79	8709CN	22.50	74C221	1.90	Z80A DMA	22.50	5.7143 MHz	4.50
74LS157N	.75	8750CJ	13.95	74C905	6.00	Z80 SIO/0	23.95	6.5536 MHz	4.50
74LS162N	.95	LD130	9.95	74C906	.75	Z80A SIO/0	28.95	14.31818 MHz	4.25
74LS163N	.95	3402D2JV-F	7.50	74C914	1.95	Z80 SIO 1	15.50	18.432 MHz	4.50
74LS174N	.95	ICL7103	9.50	74C922	5.00	Z80A SIO 1	23.90	22.1184 MHz	4.50
74LS190N	1.00	ICL7107	14.25	74C923	5.50	Z80 SIO 2	23.95		
74LS221N	1.19			74C925	6.75	Z80A SIO 2	28.95	**KEYBOARD ENCODERS**	
74LS258N	.69	**CMOS**		74C926	6.95	Z80B CTC	17.95	AY5-2376	11.95
74LS367N	.69	CD4000	.25	74C927	6.95	Z80B PIO	17.95	AY5-3600	17.95
		CD4001	.35			8212	2.25	74C922	5.49
LINEAR		CD4002	.35	**INTERFACE**		8214	3.90	74C923	5.50
CA3045	.90	CD4006	.95	8095	.65	8216	2.25	MM5740	7.95
CA3046	1.10	CD4007	.25	8096	.65	8224	2.50	MM74C89	
CA3081	1.80	CD4008	.95	8097	.55	8228	4.95		
CA3082	1.90	CD4009	.45	8098	.55	8251	5.50	**D Connectors RS232**	
CA3089	3.40	CD4010	.45	8T09	1.25	8253	8.95	DB25P	2.95
LM301AN,AH	.34	CD4011	.35	8T10	1.75	8255	5.25	DB25S	3.50
LM305H	.87	CD4012	.25	8T11	1.40	8257	9.00	Cover	1.67
LM307N	.35	CD4013	.45	8T20	4.95	8259	9.95		
LM308N	.98	CD4014	.95	8T23	1.75	1802CE plas	13.95		
LM309K	1.25	CD4015	.95	8T24	1.75	1802E plas	7.99		
LM311H,N	.64	CD4016	.45	8T25	3.20	1861P	5.95		

		0E9S	1.95
		OA15P	2.10
		OA16S	3.10
		Complete Set	9.50
		Stopwatch Kit	**26.95**
		Auto Clock Kit	**17.95**
		Digital Clock Kit	**19.75**
		RESISTORS ¼ watt 5%	
		10 per type	.03
		25 per type	.025
		100 per type	.015
		1000 per type	.012
		250 piece pack	3.95
		5 per type	5.75
		½ watt 5% per type	.04
		DIP SWITCHES	
		4-position	.85
		5-position	.90
		6-position	.90
		7-position	.95
		8-position	.95
		KEYBOARDS	
		56 key ASCII keyboard kit	$74.95
		Fully Assembled	84.95
		Enclosure Plastic	19.95
		Metal Enclosure	59.95
		LEDS	
		Red T01¾	.15
		Green, Yellow T01¾	.20
		Jumbo Red	.25
		Green, Orange, Yellow Jumbo	.25
		Chiplite LED Mounting Clips	8.5¢ 1.25
		Super red, amber green, yellow, clear	
		CONTINENTAL SPECIALTIES in stock	
		Complete line of breadboard test equip.	
		OK WIRE WRAP TOOLS in stock	
		Complete line of AP Products in stock	
		SPECIAL PRODUCTS	
		2.5 MHz Freq. Counter Kit	37.50
		30 MHz Freq. Counter Kit	47.75

AC TRANSFORMERS

FRAME	WALL PLUG
6.3V CT 600 ma $4.50 10V 2 amp	$7.95
12V 250 ma 1.95 12V 250 ma	2.95
12.6V CT 600 ma 4.95 13V CT 250 ma	3.75
12.6V CT 2 amps 9.95 12V 500 ma	4.50
12.6V CT 4 amp 8.50 12V 1 amp	5.95
12.6V CT 8 amp 10.80 12V 2 amp	7.95
24V CT 100 ma 3.95	
24V CT 600 ma 4.95	

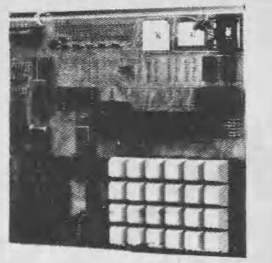
Constant Voltage Transformers (12V 1½ amp, 5V, 2¾ amp, 24V, 1½ amp) 15.00

DISPLAY LEDS

MAN72,74	CA,CA	.300 .75
DL704	CC	.300 1.25
DL707,DL707R	CA	.300 1.00
DL727,728	CA,CC	.500 1.90
DL747,750	CA,CC	.600 1.49
FND359	CC	.357 .70
FND500,507	CC,CA	.500 .99
FND503,510	CC,CA	.500 .90
FND800,807	CC,CA	.800 2.20
10 digit display		1.25
7520 Clairex photocells		.39
TIL311 Hex		9.50
MAN3640	CC	.30 .99
MAN4610	CA	.40 .99
MAN4640	CC	.40 1.20
MAN4710	CA	.40 .95
MAN4740	CC	.40 1.20
MAN6640	CC	.56 .99
MAN5710	CA	.60 .99
MAN6740	CC	.60 .99

TELEVIDEO TERMINAL
Model 950 $1010.00

4116 200ns Dynamic RAM 8/$15.40



RCA Cosmac 1802 Super Elf Computer $106.95

The Super Elf is a small single board computer that does many **big** things. It's an excellent computer for training and for learning programming with its machine language and yet it's easily **expanded** with **additional memory, Full Basic, ASCII Keyboards, video character generation, etc.**

ROM monitor; State and Mode displays; Single step; Optional address displays; Power Supply; Audio Amplifier and Speaker; Fully socketed for all IC's; Full documentation.

The **Super Elf** includes a **ROM** monitor for program loading, editing and execution with **SINGLE STEP for program debugging** which is not included in others at the same price. With **SINGLE STEP** you can see the microprocessor chip operating with the **unique Quest** address and data bus displays **before, during** and **after** executing instructions. Also, CPU mode and instruction cycle are decoded and displayed on 8 LED indicators.

An RCA 1861 **video graphics** chip allows you to connect to your own TV with an inexpensive video modulator to do graphics and games. There is a **speaker system** included for writing your own music or using many music programs already written. The speaker amplifier may also be used to drive relays for control purposes.

A 24 key **HEX keyboard** includes 16 HEX keys plus **load, reset, run, wait, input, memory protect, monitor select** and **single step**. Large, on board displays provide output and optional **high and low address**. There is a 44 pin standard connector slot for PC cards and a 50 pin connector slot for the Quest Super Expansion Board. Power supply and sockets for **all** IC's are included plus a detailed 127 pg. instruction manual which now includes over 40 pgs. of software info, including a series of lessons to help get you started and a music program and graphics target game. Many schools and universities are using the Super Elf as a course of study. OEM's use it for training and R&D.

Remember, other computers only offer Super Elf features at additional cost or not at all. **Compare before you buy. Super Elf Kit $106.95, High address option $8.95, Low address option $9.95. Custom Cabinet** with drilled and labelled plexiglass front panel **$24.95.** All metal Expansion Cabinet, painted and silk screened, with room for 5S-100 boards and power supply **$57.00. NiCad Battery Memory Saver Kit $6.95.** All kits and options also completely assembled and tested.

Questdata, a software publication for 1802 computer users is available by subscription for $12.00 per 12 issues. Single issues $1.50. Issues 1-12 bound $16.50.

Moews Video Graphics **$3.50.** Games and Music **$3.00**, Chip 8 Interpreter **$5.50.** Starship 4K cassette **$14.95.**

Quest Super Basic V5.0

A new enhanced version of **Super Basic** now available. Quest was the first company worldwide to ship a full size Basic for 1802 Systems. A complete function **Super Basic** by **Ron Cenker** including floating point capability with scientific notation (number range ±.17E^{38}), 32 bit integer ±2 billion; multi dim arrays; string arrays; string manipulation; cassette I/O; save and load; basic, data and machine language programs; and over 75 statements, functions and operations.

New improved faster version including **renumber** and essentially **unlimited variables.** Also, an exclusive user expandable command library.

Serial and Parallel I/O routines included

Super Basic on Cassette $55.00.

Free 14 page brochure of complete Super Elf system.

Super Expansion Board with Cassette Interface $89.95

This is truly an astounding value! This board has been designed to allow **you** to decide how you want it optioned. **The Super Expansion Board comes with 4K of low power RAM** fully addressable anywhere in 64K with built-in memory protect and a **cassette interface**. Provisions have been made for all other options on the same board and it fits neatly into the hardwood cabinet alongside the **Super Elf**. The board includes slots for up to 6K of **EPROM** (2708, 2758, 2716 or TI 2716) and is **fully socketed.** EPROM can be used for the monitor and Tiny Basic or other purposes.

A 1K Super ROM Monitor $19.95 is available as an on board option in 2708 EPROM which has been preprogrammed with a program loader/editor and error checking multi file cassette read/write software, (relocatable cassette file) another exclusive from Quest. It includes register save and readout, block move capability and video graphics driver with blinking cursor. Break points can be used with the register save feature to isolate program bugs quickly, then follow with single step. If you have the **Super Expansion Board** and **Super Monitor** the monitor is up and running at the push of a button.

Other on board options include **Parallel Input and Output Ports** with **full handshake**. They allow easy connection of an ASCII keyboard to the input port. **RS 232 and 20 ma Current Loop** for teletype or other device are on board and if you need more memory there are two **S-100** slots for static RAM or video boards. Also a 1K Super Monitor version 2 with video driver for full capability display with Tiny Basic and a video interface board. **Parallel I/O Ports $9.85, RS 232 $4.50, TTY 20 ma I/F $1.95, S-100 $4.50.** A **50 pin connector set** with ribbon cable is available at **$18.95** for easy connection between the **Super Elf** and the **Super Expansion Board.**

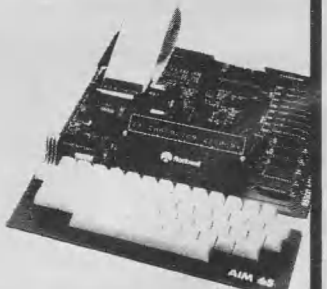
Power Supply Kit for the complete system (see Multi-volt Power Supply below).

Rockwell AIM 65 Computer

6502 based single board with full ASCII keyboard and 20 column thermal printer. 20 char. alphanumeric display ROM monitor, fully expandable **$419.00.** 4K version **$449.00**. 4K Assembler **$35.00**, 8K Basic Interpreter **$65.00**.

Special small power supply 5V 2A 24V .5A assem. in frame **$59.00.** Molded plastic enclosure to fit both AIM 65 and power supply **$52.50.** AIM 65 1K in cabinet with power supply, switch, fuse, cord assem. **$559.00.** 4K **$579.00. A65/40-5000 AIM 65/40 w/16K RAM and monitor $1295.00.** RAM Board Kit (16K, **$195**) (32K, **$215**). VD640 Video Interface Kit **$119.00.** A&T **$149.00.** Complete AIM 65 in thin briefcase with power supply **$518.00.** Special Package Price 4K AIM, 8K Basic, power supply, cabinet **$629.00**

AIM 65/KIM/SYM/Super Elf 44 pin expansion board, board with 3 connectors **$22.95.**



Elf II Adapter Kit $24.95

Plugs into Elf II providing Super Elf 44 and 50 pin plus S-100 bus expansion. (With Super Expansion). High and low address displays, state and mode LED's optional **$18.00.**

Super Color S-100 Video Kit $129.95

Expandable to 256 x 192 high resolution color graphics. 6847 with all display modes computer controlled. Memory mapped. 1K RAM expandable to 6K. S-100 bus 1802, 8080, 8085, Z80, etc. **Dealers: Send for excellent pricing/margin program.**

ELECTRONIC SYSTEMS KITS

Apple Peripheral Kits

SERIAL I/O INTERFACE 0 to 30,000 baud. D.T.R., Input & output from monitor or basic, or use Apple as intelligent terminal. Bd only (P/N 2) **$14.95**, Kit (P/N 2A) **$51.25**, Assembled (P/N 2C) **$62.95.**

PROTOTYPING BOARD (P/N 7907) **$21.95.**

PARALLEL TRIAC OUTPUT BOARD 8 triacs, each can switch 110V, 6A loads, Bd only (P/N 210) **$19.20,** Kit (P/N 210A) **$119.55.**

OPTO-ISOLATED INPUT BOARD 8 inputs, can be driven from TTL logic, Bd only (P/N 120) **$15.65,** Kit (P/N 120A) **$69.95.**

Interface Kits

SERIAL/PARALLEL INTERFACE Bidirectional, Baud rates from 110 to 19.2K, sw selectable polarity of input and output strobe, 5 to 8 data bits, 1 or 2 stop bits, parity odd or even or none, all characters contain a start bit, +5 & −12V required.Bd only (P/N 101) **$11.95,** Kit (P/N 101A) **$42.89.**

RS-232/TTL INTERFACE Bidirectional, requires ±12V, Kit (P/N 232A) **$9.95.**

RS-232/20mA INTERFACE Bidirectional, 2 passive opto-isolated circuits, Kit (P/N 7901A) **$14.95.**

PROM Eraser

Will erase 25 PROMs in 15 minutes. Ultraviolet, assembled. 25 PROM capacity **$37.50** (with timer **$69.50**). 6 PROM capacity OSHA/UL version **$78.50** (with timer **$108.50**)

NiCad Battery Fixer/Charger Kit

Opens shorted cells that won't hold a charge and then charges them up, all in one kit w/full parts and instructions. **$9.95**

Z80 Microcomputer

16 bit I/O, 2 MHz clock, 2K RAM, ROM Breadboard space. Excellent for control. Bare Board **$28.50.** Full Kit **$99.00.** Monitor **$20.00.** Power Supply Kit **$35.00.** Tiny Basic **$30.00.**

Modem Kit $60.00

State of the art, orig., answer. No tuning necessary. 103 compatible 300 baud. Inexpensive acoustic coupler plans included. Bd. only $17.00. Article in June *Radio Electronics*.

60 Hz Crystal Time Base Kit $4.40

Converts digital clocks from AC line frequency to crystal time base. Outstanding accuracy.

Video Modulator Kit $9.95

Convert TV set into a high quality monitor w/o affecting usage. Comp. kit w/full instruc.

Multi-volt Computer Power Supply

8v 5 amp, ±18v .5 amp, 5v 1.5 amp, −5v .5 amp, 12v .5 amp, −12v option ±5v, ±12v are regulated. Basic Kit **$35.95.** Kit with chassis and all hardware **$51.95.** Add $5.00 shipping. Kit of hardware **$16.00.** Woodgrain case **$10.00.** $1.50 shipping.

Type-N-Talk by Votrax

Text to speech synthesizer with unlimited vocabulary, built-in text to speech algorithm, 70 to 100 bits per second speech synthesizer, RS232C interface **$369.00.**

1802 16K Dynamic RAM Kit $149.00

Expandable to 64K. Hidden refresh w/clocks up to 4 MHz w/no wait states. Addl. 16K RAM **$25.00.**

S-100 4-slot expansion $ 9.95

Super Monitor VI.I Source Listing $15.00

TERMS: $5.00 min. order U.S. Funds. Calif. residents add 6% tax.
$10.00 min. VISA and MasterCard accepted. $1.00 insurance optional.
Shipping: Add 5%; orders under $25.00—10%.

FREE: Send for your copy of our NEW 1981 QUEST CATALOG. Include 88¢ stamp.

SD Systems ExpandoRAM III

256K RAM $879.95

Single User System

SBC-200, 64K ExpandoRAM II, Versafloppy II, CP/M 2.2

$995.00

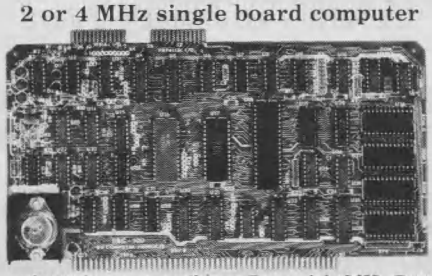
4 MHz Z-80A CPU, 64K RAM, serial I/O port, parallel I/O port, double-density disk controller, CP/M 2.2 disk and manuals, system monitor, control and diagnostic software.

Add $100.00 for upgrade to ExpandoRAM III 64K (expandable to 256K)

-All boards are assembled and tested-

SBC-200

2 or 4 MHz single board computer



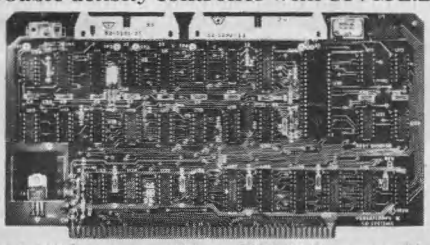
• S-100 bus compatible • Powerful 4MHz Z-80A CPU • Synchronous/asynchronous serial I/O port with RS-232 interface and software programmable baud rates up to 9600 baud • Parallel input and parallel output port • Four channel counter/timer • Four maskable, vectored interrupt inputs and a non-maskable interrupt • 1K of on-board RAM • Up to 32K of on-board ROM • System monitor PROM included

The SBC-200 is an excellent CPU board to base a microcomputer system around. With on-board RAM, ROM, and I/O, the SBC-200 allows you to build a powerful three-board system that has the same features found in most five-board microcomputers. The SBC-200 is compatible with both single-user and multi-user systems.

CPU-30200A *A & T with monitor* . **$299.95**

Versafloppy II

Double density controller with CP/M 2.2



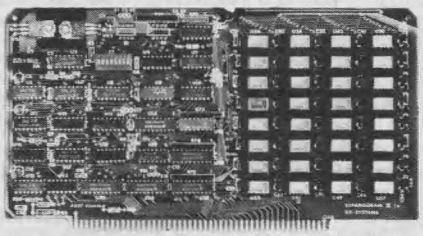
• S-100 bus compatible • IBM 3740 compatible soft sectored format • Controls single and double-sided drives, single or double density, 5¼" and 8" drives in any combination of four simultaneously • Drive select and side select circuitry • Analog phase-locked loop data seperator • Vectored interrupt operation optional • CP/M 2.2 disk and manual set included • Control/diagnostic software PROM included

The Versafloppy II is faster, more stable and more tolerant of bit shift and "jitter" than most controllers. CP/M 2.2 and all necessary control and diagnostic software are included.

IOD-1160A *A & T with CP/M 2.2* .. **$370.00**

ExpandoRAM III

64K to 256K expandable RAM board



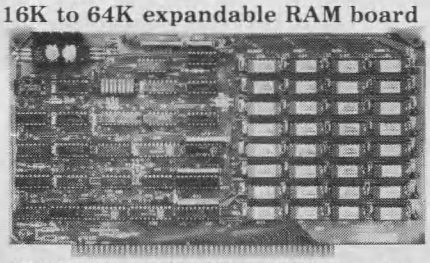
SD Systems has duplicated the famous reliability of their ExpandoRAM I and II boards in the new ExpandoRAM III, a board capable of containing 256K of high speed RAM. Utilizing the new 64K x 1 dymanic RAM chips, you can configure a memory of 64K, 128K, 192K, or 256K, all on one S-100 board. Memory address decoding is done by a programmed bipolar ROM so that the memory map may be dip-switch configured to work with either COSMOS/MPM-type systems or with OASIS-type systems.

Extensive application notes concerning how to operate the ExpandoRAM III with Cromemco, Intersystems, and other popular 4 MHz Z-80 systems are contained in the manual.

MEM-65064A	*64K A & T*	**$495.00**
MEM-65128A	*128K A & T*	**$639.95**
MEM-65192A	*192K A & T*	**$769.95**
MEM-65256A	*256K A & T*	**$879.95**

ExpandoRAM II

16K to 64K expandable RAM board



• S-100 bus compatible • Up to 4MHz operation • Expandable from 16K to 64K • Uses 16 x 1 4116 memory chips • Page mode operation allows up to 8 memory boards on the bus • Phantom output disable • Invisible on-board refresh

The ExpandoRAM II is compatible with most S-100 CPUs. When other SD System' series II boards are combined with the ExpandoRAM II, they create a microcomputer system with exceptional capabilities and features.

MEM-16630A	*16K A & T*	**$325.00**
MEM-32631A	*32K A & T*	**$345.00**
MEM-48632A	*48K A & T*	**$365.00**
MEM-64633A	*64K A & T*	**$385.00**

PROM-100

Versatile EPROM Programmer

• S-100 bus compatible • Programs 2708, 2758, 2716, 2732, 2516 EPROMs • DIP switch selection of EPROM type • 25 VDC programming pulse generated on-board • Very fast programming and verification • Zero insertion force socket • Programming software included on 8" diskette

MEM-99520K	*Kit w/software*	**$189.95**
MEM-99520A	*A & T w/software* ...	**$249.95**

Multi-User System

SBC-200, 256K ExpandoRAM III, Versafloppy II, MPC-4 COSMOS Multi-User Operating System, C BASIC II

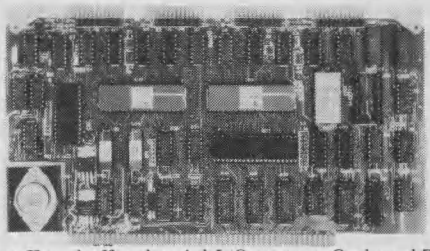
$1995.00

Two Z-80A CPUs (4 MHz), 256K RAM, 5 serial I/O ports with independently programmable baud rates and vectored interrupts, parallel input port, parallel output port, 8 counter/timer channels, real time clock, single and double sided/single or double density disk controller for 5¼" and 8" drives, up to 36K of on-board ROM, CP/M 2.2 compatible COSMOS interrupt driven multi-user disk operating system, allows up to 8 users to run independent jobs concurrently, C BASIC II, control and diagnostic software in PROM included.

-All boards are assembled and tested-

MPC-4

Intelligent communications interface



• Four buffered serial I/O ports • On-board Z-80A processor • Four CTC channels • Independently programmable baud rates • Vectored interrupt capability • Up to 4K of on-board PROM • Up to 2K of on-board RAM • On-board firmware

This is not just another four-port serial I/O board! The on-board processor and firmware provide sufficient intelligence to allow the MPC-4 to handle time consuming I/O tasks, rather than loading down your CPU. To increase overall efficiency, each serial channel has an 80 character input buffer and a 128 character output buffer. The on-board firmware can be modified to make the board SDLC or BISYNC compatible. In combination with SD's COSMOS operating system (which is included with the MPC-4), this board makes a perfect building block for a multi-user system.

IOI-1504A *A & T with COSMOS* .. **$495.00**

Place Orders Toll Free

Continental U.S. **800-421-5500**

Inside California **800-262-1710**

For Technical Inquires or Customer Service call:

213-973-7707

JADE

Computer Products

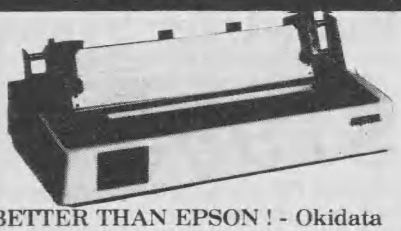
4901 W. Rosecrans, Hawthorne, Ca 90250

TERMS of SALE: Cash, checks, credit cards, or Purchase Orders from qualified firms and institutions. **Minimum Order $15.00.** California residents add 6% tax. Minimum shipping & handling charge $3.00. **Pricing & availibility subject to change**

JADE Computer Products

Sunnyvale • Woodland Hills • Hawthorne • San Diego

Printers



BETTER THAN EPSON ! - Okidata

Microline 82A *80/132 column, 120 CPS, 9 x 9 dot matrix, friction feed, pin feed, adjustable tractor feed (removable), handles 4 part forms up to 9.5" wide, rear & bottom feed, paper tear bar, 100% duty cycle/200,000,000 character print head, bi-directional/logic seeking, both serial & parallel interfaces included, front panel switch & program control of 10 different form lengths, uses inexpensive spool type ribbons, double width & condensed characters, true lower case descenders & graphics*

PRM-43082 *with FREE tractor* **$544.95**

Microline 83A *132/232 column, 120 CPS, handles forms up to 15" wide, plus all the features of the 82A.*

PRM-43083 *with FREE tractor* **$774.95**

Microline 84 *132/232 column, 200 CPS, full dot graphics built in, handles forms up to 15" wide, plus all the features of the 83A.*

PRM-43083 *with FREE tractor* ... **$1249.95**

PRA-27081 *Apple card* **$39.95**
PRA-27082 *Apple cable* **$19.95**
PRA-27087 *TRS-80 cable* **$24.95**
PRA-43081 *Hi speed 2K serial board* **$169.95**
PRA-43080 *Extra ribbons pkg. of 2* ... **$9.95**

INEXPENSIVE PRINTERS - Epson

MX-70 *80 column, 80 CPS, 5 x 7 dot matrix, adjustable tractor feed, & graphics*

PRM-27070 *List $459* **$399.95**

MX-80 *80 column, 80 CPS, bi-directional/logic seeking printing, 9 x 9 dot matrix, adjustable tractor feed, & 64 graphics characters*

PRM-27080 *List $645* **$469.95**

MX-80FT *same as MX-80 with friction feed added.*

PRM-27082 *List $745* **$559.95**

MX-100 *132 column, correspondence quality, graphics, up to 15" paper, friction feed & adjustable tractor feed, 9 x 9 dot matrix, 80 CPS.*

PRM-27100 *List $945* **$759.95**

PRA-27084 *Serial interface* **$69.95**
PRA-27088 *Serial intf & 2K buffer* .. **$144.95**
PRA-27081 *Apple card* **$74.95**
PRA-27082 *Apple cable* **$22.95**
PRA-27086 *IEEE 488 card* **$52.95**
PRA-27087 *TRS-80 cable* **$32.95**
PRA-27085 *Graftrax II* **$95.00**
PRA-27083 *Extra ribbon* **$14.95**

Modems

SMARTMODEM - Hayes

Sophisticated direct-connect auto-answer/auto-dial modem, touch-tone or pulse dialing, RS-232C interface, programmable

IOM-5400A *Smartmodem* **$249.95**
IOK-1500A *Hayes Chronograph* ... **$199.95**

CAT MODEMS - Novation

CAT *300 baud, acoustic, answer/orginate*

IOM-5200A *List $189.95* **$149.95**

D-CAT *300 baud direct connect, answer/orginate*

IOM-5201A *List $199.95* **$169.95**

AUTO-CAT *Auto answer/orginate, direct connect*

IOM-5230A *List $299.95* **$239.95**

Apple-CAT - Novation

Software selectable 1200 or 300 baud, direct connect, auto-answer auto-dial, auxiliary 3-wire RS232C serial port for printer.

IOM-5232A *Save $50.00!!!* **$325.00**

Accessories for Apple

16K MEMORY UPGRADE

Add 16K of RAM to your TRS-80, Apple, or Exidy in just minutes. We've sold thousands of these 16K RAM upgrades which include the appropriate memory chips (as specified by the manufacturer), all necessary jumper blocks, fool-proof instructions, and our 1 year guarantee.

MEX-16100K *TRS-80 kit* **$25.00**
MEX-16101K *Apple kit* **$25.00**
MEX-16102K *Exidy kit* **$25.00**

16K RAM CARD - for Apple II

Expand your Apple to 64K, 1 year warranty

MEX-16500A *Save $70.00 !!!* **$129.95**

Z-80* CARD for APPLE

Two computers in one, Z-80 & 6502, more than doubles the power & potential of your Apple, includes Z-80 CPU card, CP/M 2.2, & BASIC-80*

CPX-30800A *A & T* **$299.95**

8" DISK CONTROLLER

New from Vista Computer, single or double sided, single or double density, compatible with DOS 3.2/3.3, Pascal, & CPM 2.2, Shugart & Qume compatible

IOD-2700A *A & T* **$499.95**

2 MEGABYTES for Apple II

Complete package includes: Two 8" double-density disk drives, Vista double-density 8" disk controller, cabinet, power supply, & cables, DOS 3.2/3.3, CP/M 2.2, & Pascal compatible.

1 MegaByte Package *(Kit)* **$1495.00**
1 MegaByte Package *(A & T)* **$1695.00**
2 MegaByte Package *(Kit)* **$1795.00**
2 MegaByte Package *(A & T)* **$1995.00**

DISK DRIVES - Micro Sci

Inexpensive disk drives for your Apple

A2 *Direct replacement for Apple Disk II, works with Apple II controller as first or second drive.*

MSM-123101 *Micro Sci A2* **$429.95**

A40 *40 track drive for Apple II. Improved storage capacity and speed over Apple Brand drives - requires Micro Sci controller.*

IOD-2340A *Micro Sci A40* **$399.95**

A70 *70 track drive for Apple II. Twice the storage capacity and three times faster than Apple Brand drives - requires Micro Sci controller*

IOD-2370A *Micro Sci A70* **$499.95**

Micro Sci Controller *Disk controller for up to two Micro Sci A40 or A70 disk drives, DOS 3.2, 3.3, Pascal, and Z-80 SoftCard compatible, includes utility disk and 40/70 track patch.*

IOD-2300A *Micro Sci controller* **$95.00**

VISION 80 - Vista Computer

80 column x 24 line video card for Apple II, 128 ASCII characters, upper and lower case, 9 x 10 dot matrix with 3 dot descenders, standard data media terminal control codes, CP/M Pascal & Fortran compatible, 50/60 Hz

IOV-2400A *Vista Vision 80* **$375.00**

AIO, ASIO, APIO - S.S.M.

Parallel & serial interface for your Apple (see Byte pg 11)

IOI-2050K *Par & Ser kit* **$139.95**
IOI-2050A *Par & Ser A & T* **$169.95**
IOI-2052K *Serial kit* **$89.95**
IOI-2052A *Serial A & T* **$99.95**
IOI-2054K *Parallel kit* **$69.95**
IOI-2054A *Parallel A & T* **$89.95**

CPS MULTICARD - Mtn. Computer

Three cards in one! Real time clock calendar, serial interface, & parallel interface - all on one card.

IOX-2300A *A & T* **$199.95**

Single Board Computer

Z-80 STARTER KIT - SD Systems

Complete Z-80 microcomputer with RAM, ROM, I/O, keyboard, display, kludge area, manual, & workbook

CPS-30100K *KIT* **$299.95**
CPS-30100A *A & T* **$469.95**

SYM-1 - Synertek Systems

Single board computer with 1K of RAM, 4K of ROM, key-pad, LED display, 20ma & cassette interface on board.

CPK-50020A *A & T* **$249.95**

VIC 20 - Commodore

Complete personal computer with 5K RAM, full color, 61 key keyboard, 4 dual special-function keys, serial ports, cassette port, composite video output (connects to standard color TV set), BASIC language, & expansion port.

COM-VIC20 *VIC-20* ..... **Under $300.00**

PERSONAL COMPUTERS

Also available from Jade - Call for Price and Info

AIM-65, Altos, Apple II, Atari, Commodore, California Computer Sys Hewlett-Packard, Intersystems Jade, NEC, Novell, SD Systems SYM-1, Xerox, and more...

Video Monitors

HI-RES 12" GREEN - Zenith

15 MHz bandwidth, 700 lines/inch, P31 green phosphor, switchable 40 or 80 columns, small, light-weight & portable.

VDM-201201 *List price $150.00* **$118.95**

12" GREEN SCREEN - NEC

20 MHz, P31 phosphor video monitor with audio, exceptionally high resolution - A fantastic monitor at a very reasonable price

VDM-651200 *Special Sale Price* **$199.95**

12" COLOR MONITOR - NEC

Hi-res monitor with audio & sculptured case

VDC-651212 *Color Monitor* **$479.95**
NEC-1202D *RGB color monitor* ... **$1045.00**

Leedex / Amdek

Reasonably priced video monitors

VDM-801210 *Video 100 12" B&W* ... **$139.95**
VDM-801230 *Video 100-80 12" B& W* **$179.95**
VDM-801250 *12" Green Phospor* **$169.95**
VDC-801310 *13" Color I* **$379.95**
VDC-801320 *Color II* **$895.00**
IOV-2300A *DVM board for Apple* .. **$199.95**

Video Terminals

TELEVIDEO 910

Full featured - inexpensive terminal

VDT-901210 *List 795.00* **$695.00**

TELEVIDEO 950

VDT-901250 *List $1195.00* **$995.00**

AMBER SCREEN - Volker Craig

Detachable keyboard, amber on black display, 7 x 9 dot matrix, 10 program function keys, 14 key numeric pad, 12" non-glare screen, 50 to 19,200 baud, direct cursor control, auxiliary bi-directional serial port

VDT-351200 *List $795.00* **$645.00**

VIEWPIONT - ADDS

Detachable keyboard, serial RS232C interface, baud rates from 110 to 19,200, auxiliary serial output port, 24 x 80 display.

VDT-501210 *Sale Priced* **$639.95**

DIALOGUE 80 - Ampex

VDT-230080 *List $1195.00* **$895.00**

JADE Computer Products

FREE 1982 CATALOG

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S-100 CPU Boards

THE BIG Z* - Jade

2 or 4 MHz switchable Z-80 CPU with serial I/O, accomodates 2708, 2716, or 2732 EPROM, baud rates from 75 to 9600*

CPU-30201K *Kit* **$139.95**
CPU-30201A *A & T* **$189.95**
CPU-30200B *Bare board* **$35.00**

2810 Z-80* CPU - Cal Comp Sys

2/4 MHz Z-80A CPU with RS-232C serial I/O port and on-board MOSS 2.2 monitor PROM, front panel compatible.*

CPU-30400A *A & T* **$269.95**

CB-2 Z-80 CPU - S.S.M.

2 or 4 MHz Z-80 CPU board with provision for up to 8K of ROM or 4K of RAM on board, extended addressing, IEEE S-100, front panel compatible.

CPU-30300K *Kit* **$239.95**
CPU-30300A *A & T* **$299.95**

S-100 PROM Boards

PROM-100 - SD Systems

2708, 2716, 2732 EPROM programmer w/software

MEM-99520K *Kit* **$189.95**
MEM-99520A *A & T* **$249.95**

PB-1 - S.S.M.

2708, 2716 EPROM board with built-in programmer

MEM-99510K *Kit* **$154.95**
MEM-99510A *A & T* **$219.95**

EPROM BOARD - Jade

16K or 32K uses 2708's or 2716's, 1K boundary

MEM-16230K *Kit* **$79.95**
MEM-16230A *A & T* **$119.95**

S-100 Video Boards

VB-3 - S.S.M.

80 characters x 24 lines expandable to 80 x 48 for a full page of text, upper & lower case, 256 user defined symbols, 160 x 192 graphics matrix, memory mapped, has key board input.

IOV-1095K *4 MHz kit* **$349.95**
IOV-1095A *4 MHz A & T* **$439.95**
IOV-1096K *80 x 48 upgrade* **$39.95**

VDB-8024 - SD Systems

80 x 24 I/O mapped video board with keyboard I/O, and on-board Z-80A.*

IOV-1020A *A & T* **$459.95**

VIDEO BOARD - S.S.M.

64 characters x 16 lines, 128 x 48 matrix for graphics, full upper/lower case ASCII character set, numbers, symbols, and greek letters, normal/reverse/blinking video, S-100.

IOV-1051K *Kit* **$149.95**
IOV-1051A *A & T* **$219.95**
IOV-1051B *Bare board* **$34.95**

S-100 Motherboards

ISO-BUS - Jade

Silent, simple, and on sale - a better motherboard

6 Slot (5¼" x 8⅝")

MBS-061B *Bare board* **$19.95**
MBS-061K *Kit* **$39.95**
MBS-061A *A & T* **$49.95**

12 Slot (9¾" x 8⅝")

MBS-121B *Bare board* **$29.95**
MBS-121K *Kit* **$69.95**
MBS-121A *A & T* **$89.95**

18 Slot (14½" x 8⅝")

MBS-181B *Bare board* **$49.95**
MBS-181K *Kit* **$99.95**
MBS-181A *A & T* **$139.95**

S-100 RAM Boards

MEMORY BANK - Jade

4 MHz, S-100, bank selectable, expandable from 16K to 64K

MEM-99730B *Bare Board* **$49.95**
MEM-99730K *Kit no RAM* **$199.95**
MEM-32731K *32K Kit* **$239.95**
MEM-64733K *64K Kit* **$279.95**
Assembled & Tested ..... add **$50.00**

64K RAM - Calif Computer Sys

4 MHz bank port / bank byte selectable, extended addressing, 16K bank selectable, PHANTOM line allows memory overlay, 8080 / Z-80 / front panel compatible.

MEM-64565A *A & T* **$575.00**

64K STATIC RAM - Mem Merchant

64K static S-100 RAM card, 4-16K banks, up to 8MHz

MEM-64400A *A & T* **$789.95**

32K STATIC RAM - Jade

2 or 4 MHz expandable static RAM board uses 2114L's

MEM-16151K *16K 4 MHz kit* **$169.95**
MEM-32151K *32K 4 MHz kit* **$299.95**
Assembled & tested ..... add **$50.00**

16K STATIC RAM - Mem Merchant

4 MHz 16K static RAM board, IEEE S-100, bank selectable, Phantom capability, addressable in 4K blocks, "disable-able" in 1K segments, extended addressing, low power

MEM-16171A *A & T* **$164.95**

S-100 Disk Controllers

DOUBLE-D - Jade

Double density controller with the inside track, on-board Z-80A, printer port, IEEE S-100, can function on an interrupt driven buss*

IOD-1200K *Kit* **$299.95**
IOD-1200A *A & T* **$375.00**
IOD-1200B *Bare board* **$59.95**

DOUBLE DENSITY - Cal Comp Sys

5¼" and 8" disk controller, single or double density, with on-board boot loader ROM, and free CP/M 2.2 and manual set.*

IOD-1300A *A & T* **$374.95**

S-100 I/O Boards

S.P.I.C. - Jade

Our new I/O card with 2 SIO's, 4 CTC's, and 1 PIO

IOI-1045K *2 CTC's, 1 SIO, 1 PIO* .. **$179.95**
IOI-1045A *A & T* **$239.95**
IOI-1046K *4 CTC's, 2 SIO's, 1 PIO* **$219.95**
IOI-1046A *A & T* **$299.95**
IOI-1045B *Bare board w/ manual* ... **$49.95**

I/O-4 - S.S.M.

2 serial I/O ports plus 2 parallel I/O ports

IOI-1010K *Kit* **$179.95**
IOI-1010A *A & T* **$249.95**
IOI-1010B *Bare board* **$35.00**

S-100 Mainframes

MAINFRAME - Cal Comp Sys

12 slot S-100 mainframe with 20 amp power supply

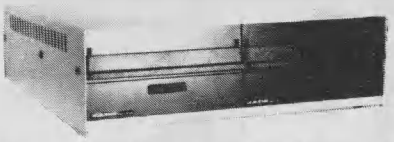
ENC-112105 *Kit* **$329.95**
ENC-112106 *A & T* **$399.95**

EPROM ERASER - Spectronics

Ultra-violet EPROM erasers

XME-3100A *With out timer* **$69.50**
XME-3101 *With timer* **$94.50**
XME-3200 *Economy Model* **$39.95**

Disk Drives



Handsome metal cabinet with proportionally balanced air flow system • Rugged dual drive power supply • Power cable kit • Power switch, line cord, fuse holder, cooling fan • Never-Mar rubber feet • All necessary hardware to mount 2-8" disk drives, power supply, and fan • Does not include signal cable

Dual 8" Subassembly Cabinet

END-000420 *Bare cabinet* **$59.95**
END-000421 *Cabinet kit* **$225.00**
END-000431 *A & T* **$359.95**

8" Disk Drive Subsystems
Single Sided, Double Density

END-000423 *Kit w/2 FD100-8Ds* . **$924.95**
END-000424 *A & T w/2 FD100-8Ds* **$1124.95**
END-000433 *Kit w/2 SA-801Rs* ... **$999.95**
END-000434 *A & T w/2 SA-801Rs* **$1195.00**

8" Disk Drive Subsystems
Double Sided, Double Density

END-000426 *Kit w/2 DT-8s* **$1224.95**
END-000427 *A & T w/2 DT-8s* ... **$1424.95**
END-000436 *Kit w/2 SA-851Rs* .. **$1295.00**
END-000437 *A & T w/2 SA-851Rs* **$1495.00**

5¼" Disk Drives

***Shugart SA400L** sngl-sided dbl-density 40 track*
MSM-104000 .. $234.95 ea 2 for **$224.95 ea**

***Shugart SA450** dbl-sided dbl-density 70 track*
MSM-104500 .. $349.95 ea 2 for **$329.95 ea**

***Qume DT-5** dbl-sided dbl-density 80 track*
MSM-750050 .. $359.95 ea 2 for **$349.95 ea**

***MPI B-51** sngl-sided dbl-density 40 track*
MSM-155100 .. $234.95 ea 2 for **$224.95 ea**

***MPI B-52** dbl-sided dbl-density 40 track*
MSM-155200 .. $344.95 ea 2 for **$334.95 ea**

***MPI B-91** sngl-sided dbl-density 77 track*
MSM-155300 .. $369.95 ea 2 for **$359.95 ea**

***MPI B-92** dbl-sided dbl-density 77 track*
MSM-155400 .. $469.95 ea 2 for **$459.95 ea**

8" Disk Drives

***Shugart SA801R** single-sided double-density*
MSF-10801R .. $394.95 ea 2 for **$389.95 ea**

***Shugart SA851R** double-sided double-density*
MSF-10851R .. $554.95 ea 2 for **$529.95 ea**

***Qume DT-8** double-sided double-density*
MSF-750080 .. $524.95 ea 2 for **$499.95 ea**

***Siemens FDD 100-8** sngl-sided dbl-density*
MSF-201120 .. $384.95 ea 2 for **$349.95 ea**

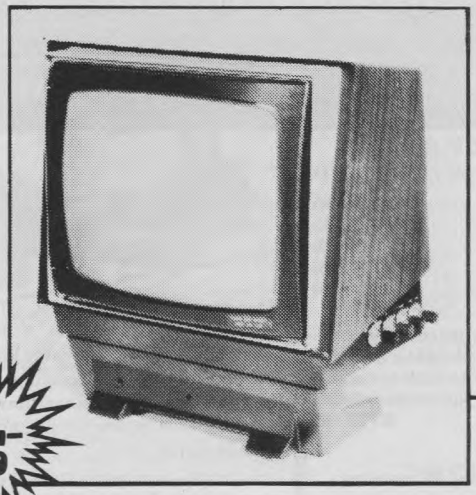
BUS PROBE - Jade

S-100 diagnostic analyzer board, dynamic visual display of all 96 IEEE S-100 signals, aids in real time analysis of faulty hardware and software

TSX-200B *Bare Board* **$59.95**
TSX-200K *Kit* **$119.95**
TSX-200A *A & T* **$149.95**

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Does it again. . . . high quality Sylvania monitors at the lowest prices ever. These monitors have been thoroughly checked and guaranteed.



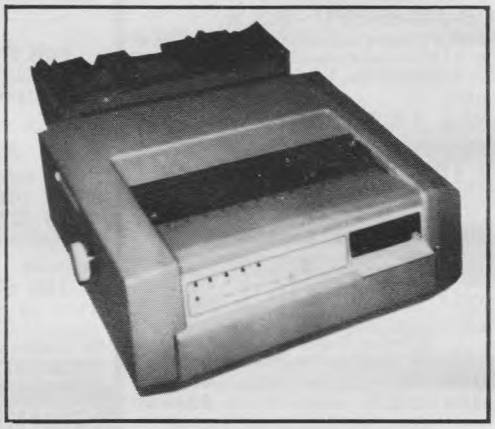
MONITORS

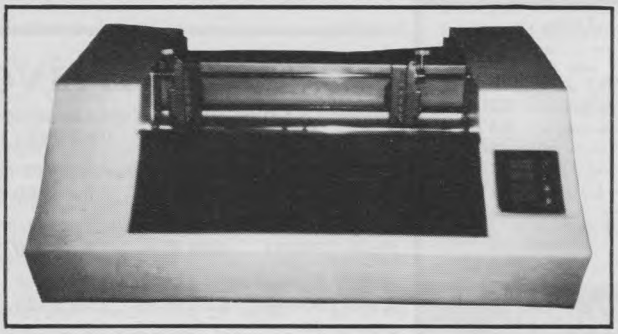
12'' black & white monitor. Wide band, will display 80 x 24 char. 10K or 75Ω input impedance, composite video input. Transformer power supply.
Shpt. Wt. 30#
Price: $55 ea.
Used with all computers such as: TRS-80, Apple, and many others.
Complete manual $5.00.

GE TERMINET 300 PRINTER

- Pin feed—9'' paper
- Receive only
- RS232 interface
- Upper & lowercase
- 80 print positions
- ASCII code
- 30 CPS
- Runs on most micros including TRS-80

PRICE—$150.00
f.o.b. our warehouse Shpt. wt. 75#





CENTRONICS PRINTER—MODEL 103

(Limited quantities)

This is a high speed impact printer using a 9 x 7 or 5 x 7 dot matrix for character generation. Prints in both forward and reverse directions. 165 cps and up to 340 lines per minute. Contains an off-line test capability to allow operator to independently exercise the printer. Runs either serial or parallel interface.

Excellent condition ONLY—$550.00
Shpt. wt. 150# f.o.b. our warehouse
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USACII ENCODED KEYBOARDS

SOLID STATE KEYS CONTOURED TYPING SURFACE
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COMPLETE 6 PAGES SPEC. MANUAL.
PRICE: $25.00 f.o.b. our warehouse Shpt. 5#

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12 x 80 CHARACTER BAUD RATE 110-9600
SHPT. WT. 47# PRICE: $150.00
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All items have been thoroughly checked and are in excellent working condition.

- Test Equipment
- Power Supply Components
- Power Supplies
- Communication Equipment
- Pulse Equipment

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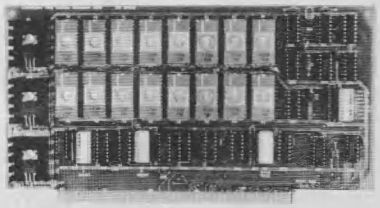
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32K S-100 EPROM CARD
NEW!



$79.95 KIT

USES 2716's

Blank PC Board - $34

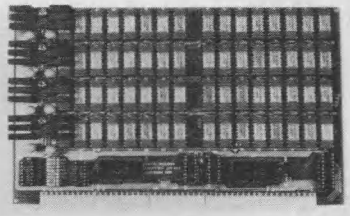
ASSEMBLED & TESTED ADD $30

SPECIAL: 2716 EPROM's (450 NS) Are $9.95 Ea. With Above Kit.

KIT FEATURES:
1. Uses +5V only 2716 (2Kx8) EPROM's.
2. Allows up to 32K of software on line!
3. IEEE S-100 Compatible.
4. Addressable as two independent 16K blocks.
5. Cromemco extended or Northstar bank select.
6. On board wait state circuitry if needed.
7. Any or all EPROM locations can be disabled.
8. Double sided PC board, solder-masked, silk-screened.
9. Gold plated contact fingers.
10. Unselected EPROM's automatically powered down for low power.
11. Fully buffered and bypassed.
12. Easy and quick to assemble.

32K SS-50 RAM

$259.95 KIT



For 2MHZ Add $10

Blank PC Board $50

For SWTPC 6800 - 6809 Buss

Support IC's and Caps $19.95

Complete Socket Set $21.00

Fully Assembled, Tested, Burned In Add $30

At Last! An affordable 32K Static RAM with full 6809 Capability.

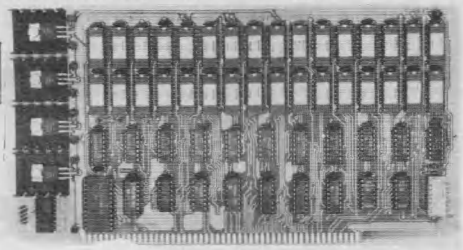
FEATURES:
1. **Uses proven low power 2114 Static RAMS.**
2. **Supports SS50C - EXTENDED ADDRESSING.**
3. **All parts and sockets included.**
4. **Dip Switch address select as a 32K block.**
5. **Extended addressing can be disabled.**
6. **Works with all existing 6800 SS50 systems.**
7. **Fully bypassed. PC Board is double sided, plated thru, with silk screen.**

16K STATIC RAM KIT-S 100 BUSS

PRICE CUT!

$149.95 KIT

FOR 4MHZ ADD $10



KIT FEATURES:
1. Addressable as four separate 4K Blocks.
2. ON BOARD BANK SELECT circuitry. (Cromemco Standard!). Allows up to 512K on line!
3. Uses 2114 (450NS) 4K Static Rams.
4. ON BOARD SELECTABLE WAIT STATES.
5. Double sided PC Board, with solder mask and silk screened layout. Gold plated contact fingers.
6. All address and data lines fully buffered.
7. Kit includes ALL parts and sockets.
8. PHANTOM is jumpered to PIN 67.
9. LOW POWER: under 1.5 amps TYPICAL from the +8 Volt Buss.
10. Blank PC Board can be populated as any multiple of 4K.

BLANK PC BOARD W/DATA-**$33**
LOW PROFILE SOCKET SET-**$12**
SUPPORT IC'S & CAPS-**$19.95**
ASSEMBLED & TESTED-**ADD $35**

OUR #1 SELLING RAM BOARD!

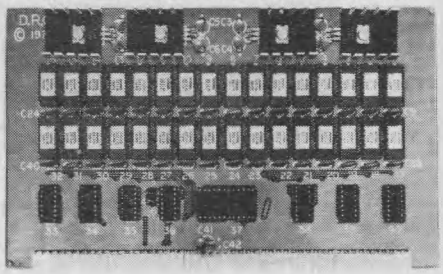
16K STATIC RAM SS-50 BUSS

PRICE CUT!

$139.95 KIT

FULLY STATIC!

FOR 2MHZ ADD $10



FOR SWTPC 6800 BUSS!

ASSEMBLED AND TESTED - $35

KIT FEATURES:
1. Addressable on 16K Boundaries
2. Uses 2114 Static Ram
3. Fully Bypassed
4. Double sided PC Board. Solder mask and silk screened layout.
5. All Parts and Sockets included
6. Low Power: Under 1.5 Amps Typical

BLANK PC BOARD—**$35** COMPLETE SOCKET SET—**$12**
SUPPORT IC'S AND CAPS—**$19.95**

NEW! **STEREO! S-100 SOUND COMPUTER BOARD** NEW!

At last, an S-100 Board that unleashes the full power of two unbelievable General Instruments AY3-8910 NMOS computer sound IC's. Allows you under total computer control to generate an infinite number of special sound effects for games or any other program. Sounds can be called in BASIC, ASSEMBLY LANGUAGE, etc.

COMPLETE KIT! **$84.95** (WITH DATA MANUAL)

BLANK PC BOARD W/DATA $31

KIT FEATURES:
- ★ TWO GI SOUND COMPUTER IC'S.
- ★ FOUR PARALLEL I/O PORTS ON BOARD.
- ★ USES ON BOARD AUDIO AMPS OR YOUR STEREO.
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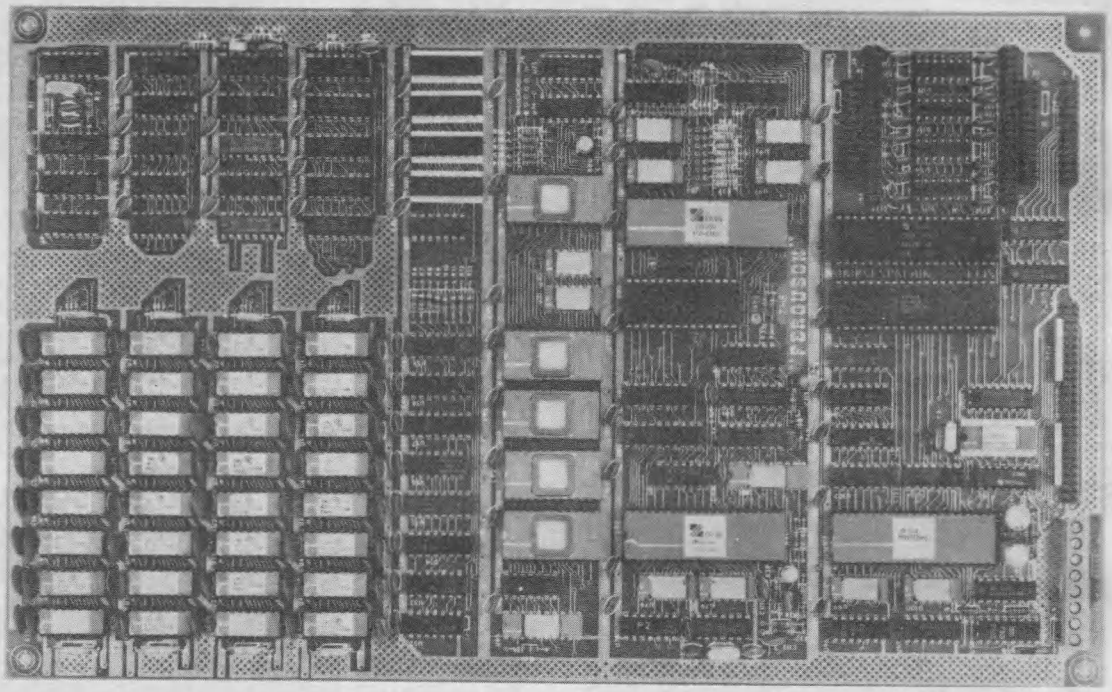
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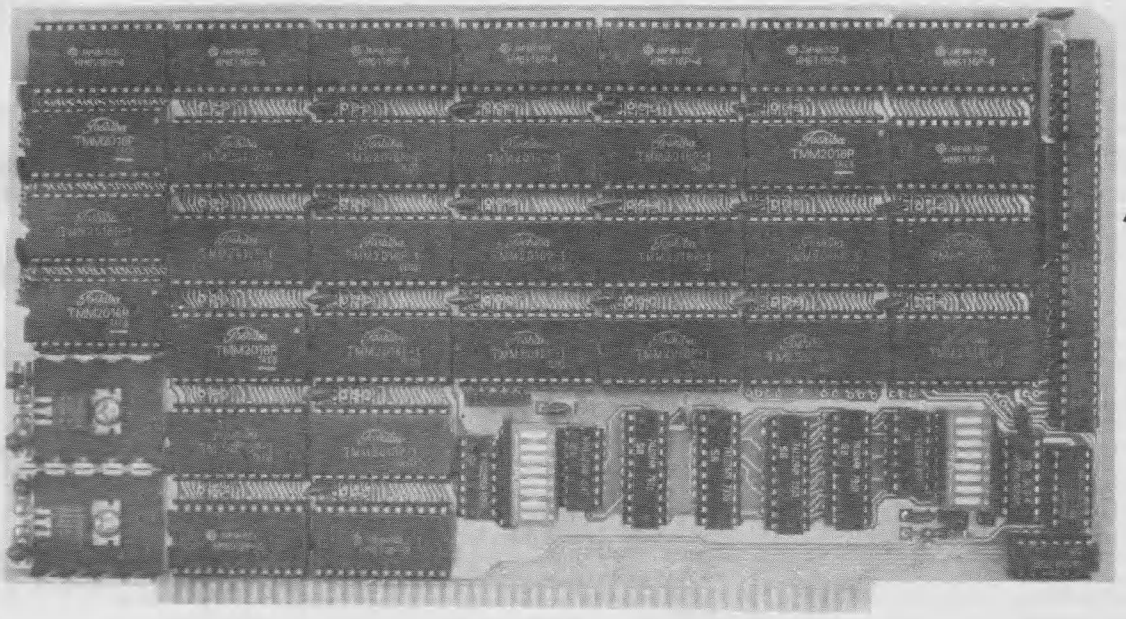
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LETTERS TO THE EDITOR

A Shortcut through the Gates

I was first amused, then concerned, about the article by Howard Rifkin in the September issue ("A Shortcut through the Gates," Howard Rifkin, p. 182). Twenty-five years ago, when I first started designing computer circuits, the diode AND and OR gates he shows were the most common way of implementing simple logic. The amusement came from the idea that these techniques would be considered novel; the concern stems from the thought that someone might try to use them without some analysis of their operations.

This is especially true of the so-called NOT gate, which is NOT a gate, but an inverter. If a NOR is made by combining Figs. 2 and 3 of the article, the inputs (points A and B) will not rise above about +1.4 V, and thus cannot be used to drive anything else. Also, it may draw excessive current from the driver. A NAND, using Figs. 1 and 3, will not work at all when driven with TTL, as the base of the transistor will never be sufficiently negative to turn the transistor off. Even with CMOS drive, the circuit has essentially zero noise margin. Cascading of the diode gates is also fraught with peril due to diode drops and other more subtle effects.

Reliable, functional circuits can be designed using diode gates and inverters, but it is definitely not as simple as this article suggests. Beware, experimenters, when something looks too good to be true. It probably isn't.

Gary J. Vincent
Richardson, TX

Response:

I will try to address Mr. Vincent's comments in order. He is quite correct in stating that these circuits were in common use 25 years ago, and as stated in the original article the AND gate was described to me by one of the engineers (who has been using it for 15 years) where I work. However, 25 years ago when Mr. Vincent was using them I was not around (or at least not working with computers) and I would guess this is true for many of *Microcomputing*'s readers. With the exception of the NOT circuit I have never seen these circuits published. So rather than considering them a novelty, the article was intended to inform

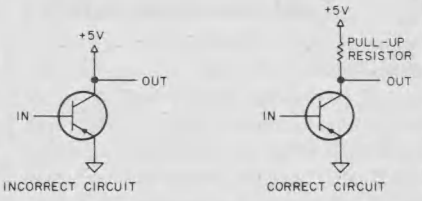


Fig. 1.

those like me who do not have Mr. Vincent's background.

In the case of the NOT circuit there are two errors. The first of these is a missing pull-up resistor between the 5 V source and the out line, which should still be connected to the transistor collector. (See Fig. 1.) The second error is that the transistor should be an NPN rather than a PNP.

Finally, I have used all of these circuits, including the corrected NOT and NAND and NOR combinations, and have found them to be reliable and functional. As stated in the article, these circuits are for emergency use when only one or two gates are needed. If you need more than that it would pay to use a 7400 series IC. If Mr. Vincent has better circuits I invite him to submit them.

Howard Rifkin
Old Bridge, NJ

Engineers Have at It

The value of the filter capacitor in J.C. Hassall's power supply design is too small as pointed out by Robert L. Ribbeck in the September issue of *Microcomputing* (p. 212). However, Mr. Ribbeck's value is also too small. The capacitor discharge time in the formula is not always equal to 6 milliseconds, but changes with the maximum and minimum voltage values (7.51 and 7.00 in this case). The capacitor discharge time is given approximately by the formula:

$$t_d = \frac{1}{4f} + \frac{1}{2\pi f} \mathrm{Sin}^{-1}\left(\frac{\mathrm{Vmin}}{\mathrm{Vmax}}\right)$$

A value of 7.35 milliseconds is obtained for the capacitor discharge time, a 23 percent increase. The minimum capacitor value should therefore be 21,600 μF.

Now we have a mystery, since Mr. Hassall has reported that with a current of 2 A there is only a .15 V ripple. With a 2A current, and using Mr. Ribbeck's formula (slightly modified), we get a capacitor value of 28,800 μF—seven times the value Mr. Hassall is using! Something is very wrong here! Or is it?

Since Mr. Hassall has not reported the ac voltage coming out of the transformer, let us make some guesses. The transformer is marked in the diagram as giving 6.3 V for an input voltage of 115 V. If the available voltage is really 125 V then the transformer's output voltage would be 6.9 V RMS, giving a peak voltage of 9.7 V. The transformer I have gives a no-load output voltage of 7 V, even though it's marked as 6.3 V.

The diodes in the bridge were assumed to have a drop of .7 V. However, diodes do not cut off abruptly. As the diode's current decreases, so does its voltage drop. Therefore, even when the forward drop across the diode has reduced to .5 V, it may still be delivering a significant charging current to the filter capacitor. We can compensate for this by assuming the diode drop is .5 instead of .7 V.

With a peak voltage of 9.7 V, a diode drop of 1 V (2 * .5V), and a minimum voltage of 6.5 V into the regulator, the minimum capacitance is 5800 μF. This value is still too high unless we remember to account for the tolerance of the 4000 μF capacitor, typically −10 percent, +50 percent.

Finally, the load is not a purely resistive load. Microcomputer boards usually have filter capacitors on the board which could significantly reduce the ripple measured at the output of the 7805. If the load were changed to a 2.5 ohm purely resistive load, I suspect the ripple would increase. Also, a load current of 2 A is very near if not over the point at which current limiting takes place in the 7805. The 7805 does not regulate very well in current limit mode.

The published design seems marginal. There are at least three ways to improve the situation:

- Replace the transformer with one having a higher output voltage, at least 8.6 V RMS.
- Replace the diodes with germanium types and increase the size of the filter capacitor to at least 10,000 μF.
- Use a regulator with a lower voltage margin. Regulators have been built which require less than a .5 V margin.

John Thomas
Memphis, TN

```
100 PRINTCHR$(147):PRINTCHR$(142):POKE59468,12
110 PRINT"      << PET PRINTER LABELS >>"
120 PRINT"          BY KEN C BARROLL - W70P",
125 REM ** DONATED TO PUBLIC DOMAIN BY THE AUTHOR **
130 PRINT"              USE NO COMMAS! "
140 PRINT"          ┌───────────────────┐"
150 PRINT"          | MR. JOHN LOSER    | ←LINE 1"
160 PRINT"          | 0 DEAD END STREET | ←LINE 2"
170 PRINT"          | NO-WHERES-VILLE   | ←LINE 3"
180 PRINT"          | LOST NATION 13    | ←LINE 4"
190 PRINT"          | SUNKEN CONTINENT  | ←LINE 5"
200 PRINT"          └───────────────────┘"
210 PRINT"   (EAT YOUR HEART OUT WALTER DRAKE!)"
220 PRINT:PRINT
230 PRINT"    CHOOSE_____>  DIRECT TO FILES - <D>"
240 PRINT"      ONE      >  MAKE NEW LABELS - <M>?"
250 GETR$:IFR$=""THEN250
260 IFR$="D"THEN 720
270 INPUT"   CHOOSE >-> 4 OR 5 5-LINE LABELS",L
280 IFL<4ORL>5THEN PRINT"":GOTO270
290 IF L=4GOTO310
300 IF L=5GOTO510
310 PRINT"LINE 1";:INPUT A$
320 PRINT"LINE 2";:INPUT B$
330 PRINT"LINE 3";:INPUT C$
340 PRINT"LINE 4";:INPUT D$
350 PRINT""
360 PRINT"":PRINTA$:PRINTB$:PRINTC$:PRINTD$
370 PRINT"POSITION LABELS IN PRINTER"
380 PRINT"IS ABOVE OK (Y OR N)?"
390 INPUTU$:IFU$="N"THEN310
400 PRINT""
410 PRINT"                 HOW MANY LABELS?"
420 INPUT"(0=REDO LABEL - 100=GOTO FILES)",N
430 IFN=0THEN 310
440 IFN=100THEN GOTO720
450 OPEN4,4
460 FORI=1TON
470 PRINT#4,A$:PRINT#4,B$:PRINT#4,C$:PRINT#4,D$:PRINT#4,CHR$(10):PRINT#4
480 NEXT I
490 CLOSE4,4
500 GOTO 410
510 PRINT"LINE 1";:INPUT A$
520 PRINT"LINE 2";:INPUT B$
530 PRINT"LINE 3";:INPUT C$
540 PRINT"LINE 4";:INPUT D$
550 PRINT"LINE 5";:INPUT E$
560 PRINT""
570 PRINT"":PRINTA$:PRINTB$:PRINTC$:PRINTD$:PRINTE$
580 PRINT"POSITION LABELS IN PRINTER"
590 PRINT"IS ABOVE OK (Y OR NO)"
600 INPUTU$:IFU$="N"THEN510
610 PRINT""
620 PRINT"          HOW MANY LABELS?"
630 INPUT"(0=REDO LABEL - 100=GOTO FILES)",N
640 IFN=0THEN510
650 IF N=100THENGOTO720
660 OPEN4,4
670 FOR I=1 TO N
680 PRINT#4,A$:PRINT#4,B$:PRINT#4,C$:PRINT#4,D$:PRINT#4,E$::PRINT#4,CHR$(10)
690 NEXT
700 CLOSE4,4
710 GOTO620
720 REM * PRINT FROM DATAFILES *
730 N=2
740 PRINT"ARE LABELS POSITIONED ..??":PRINT" ANY KEY WILL START PRINT
ER !! "
750 GETL$:IFL$=""THEN750
760 OPEN4,4
770 READ G$
780 IF G$="5"THEN 820
790 IF G$="0"THEN 860
800 PRINT#4,G$
810 GOTO770
820 REM * PRINT SPACE BETWEEN LABELS *
830 PRINT#4,CHR$(10)
840 PRINT"DATA NUMBER "N:N=N+1
850 CLOSE4,4:GOTO760
860 PRINT""
870 PRINT#4:CLOSE4,4
880 PRINT"YOU MUST REPOSITION LABELS NOW"
890 RESTORE
900 GOTO230
905 REM ** BUILD 4-LINE DATA STATEMENTS AS PER EXAMPLES BELOW
908 REM ** END WITH 'DATA 5' - LAST ONE WITH 'DATA 0'
910 DATA"THE CODE WORKS"
920 DATA"P.O.BOX 550"
930 DATA"GOLETA - CAL"
940 DATA"93116 - U.S.A."
950 DATA5
960 DATA"COMMODORE BUSINESS MACHINES"
970 DATA"681 MOORE ROAD"
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1060 DATA"SANTA CLAUS"
1070 DATA"LAT 90 - LONG 0"
1080 DATA"NORTH POLE"
1090 DATA"00000"
1100 DATA0
```

Listing 1. Label printing program.

It is apparent that Mr. Hassall failed to understand the major point of Mr. Ribbeck's letter. The main problem with his design has little to do with the transformer amperage. Given 6.3 V RMS ac, a diode forward voltage, and a regulator dropout voltage of 2 V, there is no way to obtain a glitch-free output of 5 V and 1.5 A with that (4000 μF) capacitor value.

The capacitor value Mr. Ribbeck computed from the standard approximation is a little optimistic. The exact solution of the problem gives 22,000 μF.

Mr. Hassall states that he measured the ripple of his prototype at .15 V; volts of what? It is clear from context that Mr. Ribbeck is speaking of volts peak to peak. If Mr. Hassall used a peak-responding-RMS-reading multimeter, the scale reading should be multiplied by $2\sqrt{2}$ to obtain the peak to peak value (.42 V). If he used a better multimeter, the ripple is even worse and there is no direct conversion factor. The best way is to use a scope.

The existence of a prototype that "works" is really not a relevant point. Component values vary widely and a design must allow for the worst case. The 4000 μF capacitor has a range of 3600 μF to 10,000 μF. The maximum dropout voltage for the 7805 is 2.5 V. The maximum forward voltage of silicon rectifiers is usually listed as 1.2 V. A worst case design would require 9.9 V minimum input to the rectifier bridge. The 6.3 V transformer is not adequate no matter what its amperage rating.

An 8 V, 2.7 A transformer should be adequate if used with a 10,000 μF capacitor.

If 835 mA dc is adequate, Signal Transformer Co. makes a transformer (MPC-Y-15) specially designed for this application that also provides $\pm$15 V dc at 130 mA.

James Tyrer
Apple Valley, CA

Response:

In regard to the volume of mail which has been generated as a result of the power supply article, I can say that one cannot publish and be thin-skinned.

After a third party review, I will concede that a larger filter capacitor will provide better filtering than the smaller value in the design. I remain adamant, however, that the transformer rating of 6.3 V ac at 3 A minimum will work satisfactorily. If a transformer is operated at less than approximately 50 percent of rated power capacity (the derating factor depends upon how efficient it is), the secondary voltage will be the nameplate voltage. I hope that this puts the issue to bed permanently.

J.C. Hassall
Blacksburg, VA

Multiple Label Program

Here is a multiple label printer for such things as kids' schoolbooks or Christmas lists from datafiles. This program (Listing 1) should meet most requirements of home users of the Commodore PET and CBM 2022 printer.

Ken Barroll
Seattle, WA

Who's on First?

Frank J. Derfler, Jr., in his Dial-Up Directory column (*Microcomputing*, Oct. 1981, p. 14) describes the GTE Telenet Telemail service and how Telenet is really "looking for corporate accounts" and how "IBS took advantage of this situation, and is subleasing time to individuals" from their corporate account. Unfortunately, by the time the article appeared the information was no longer accurate.

Telephone Software Connection had been providing individual access to Telemail many months before IBS came on the scene and is still providing it now that IBS no longer is. In addition, it is our understanding that GTE Telenet does not allow users simply to order a corporate account and then "sublease" the service as was described by Mr. Derfler in his column.

Ed Magnin, president
Telephone Software Connection, Inc.
Torrance, CA

Printer Interface Mod

Just in case someone wants to build a TRS-80 printer interface based on the ideas of Rod Hallen (*Microcomputing*, Jan. 1980, p. 134), I encountered a problem which held me up quite a bit in my first real hardware project. The NAND gate IC3C produces a *low* pulse for the 37E8WRITE. However, to enable the latch IC5, a *high* pulse is required on pins 12 and 23. The insertion of an inverter in the line to these pins solved my problem. This, perhaps, is a conceptually simpler modification than that by Eric Keener, in the Dec. 1980 issue (p.23).

Incidentally, I use the interface on the expansion port of my EI to drive a plotter. I was lucky enough to find a 5 V supply on pin 39 of the bus.

Albert Nijenhuis
Philadelphia, PA

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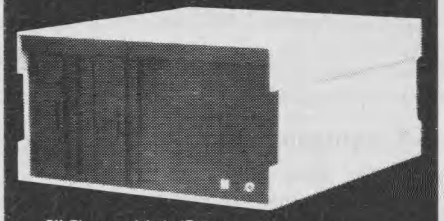
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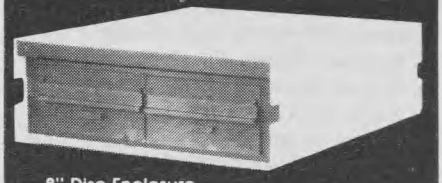
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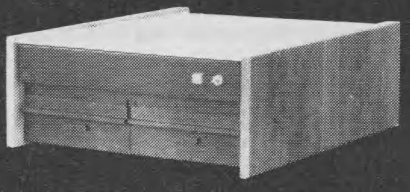
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NEW PRODUCTS

Edited by Linda Stephenson

Not Just Another Chess Game
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Championship Chess

The Mate is a microcomputer peripheral that puts chess back in the player's hands. It includes a true sensor chessboard with magnetic chess pieces, the appropriate interface board for Apple II, PET or TRS-80 and chess software on cassette. All the player does is move the pieces; the computer senses the move and responds with a counter move through LEDs on the chessboard. The computer display screen will continue to show the game in progress. The accessory interface software is documented so the user can interface his own chess program if he wishes. Price is approximately $300.

Destiny Products, 207 N. Kirby St., Garland, TX 75042. Reader Service number 463.

Floppy Disks

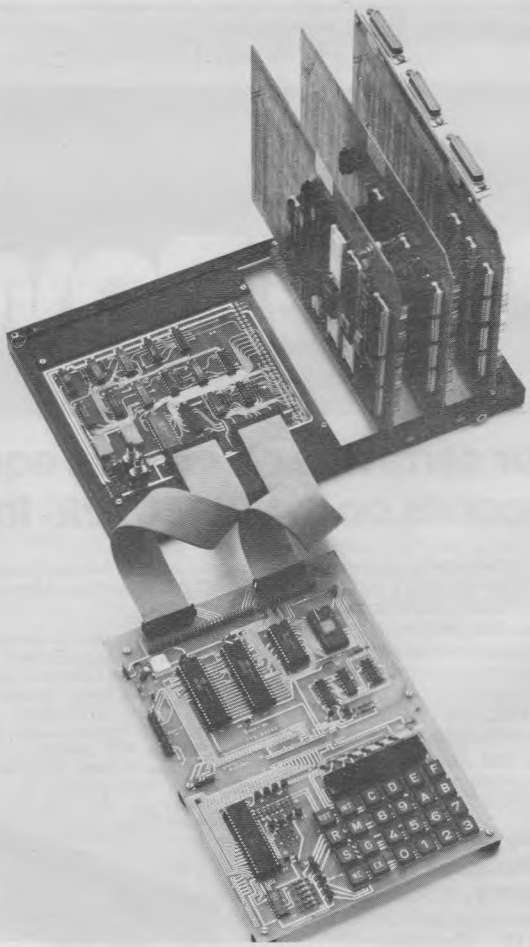
Leading Edge Products, Inc., 225 Turnpike St., Canton, MA 02021, has announced a new line of 5¼-inch floppy disks called Elephant Memory Systems. The line includes seven consecutively numbered models that cover the requirements of virtually all micros. The series includes single- and double-density, single- and double-sided, soft-sectored and ten- and 16-sectored disks. The disks have reinforced hub rings and are designed to handle more than 12 million passes on a single track without showing significant wear or causing errors. The disks are certified error-free on a range of certifiers and drive manufacturers including Shugart, Micropolis, BASF, Pertec and Qume. Reader Service number 497.



Destiny Products' Mate peripheral for popular microcomputers.

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The Sintel-85 8085-based microcomputer.



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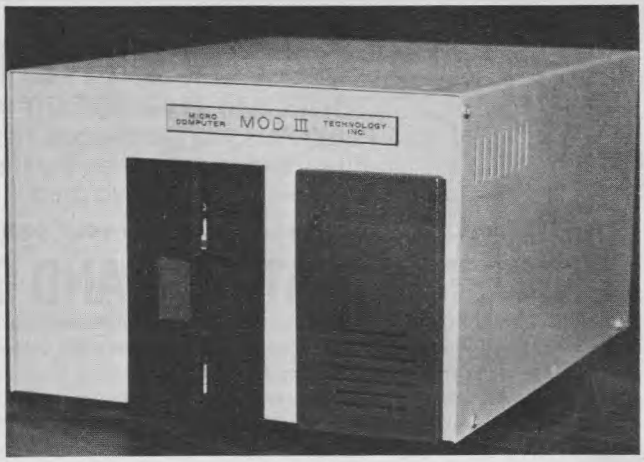
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Sintel Systems Ltd., 13 Ovadia St., POB 9209, Haifa, Israel 34564. Reader Service number 464.

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MTI is offering a 5M-byte Winchester hard-disk system for use with the TRS-80 Model III. Just plug its cable connector into the rear expansion port. The external Winchester system uses the Micro Systems operating system version 3.3.9, which is file-compatible with TRS-DOS. The 5M-byte Model 1421 is a self-contained unit including a Winchester drive, controller, power supply and cables, priced at $2799. The Micro Systems DOS plus hard-disk operating system costs $299.

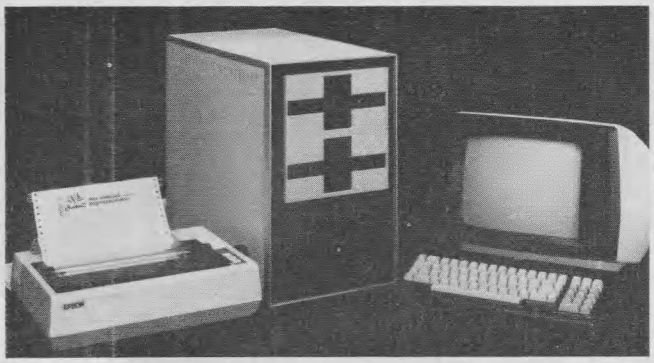
Microcomputer Technology, Inc., 3304 W. MacArthur Blvd., Santa Ana, CA 92704. Reader Service number 465.

Portable Communications

The Axlon Hotline Personal Communication Terminal can be used to transmit and retrieve information from databases as diverse as a personal telephone directory and the New York Stock Exchange. The terminal measures 1-5/8 × 3-9/16 × 6-3/4 inches and weighs less than 11 ounces. It provides a built-in modem. The tactile alphanumeric keyboard with 43 functional keys supports a 64-character ASCII set in up-



The Hotline Personal Communication Terminal from Axlon, Inc.



The Xitex XM800S is shown here with separate printer and video display.

percase only. The screen is a 16-character fluorescent display, titled for easy viewing. The terminal offers a 96-character display memory that can be scrolled 16 characters at a time, and a 16-character display memory in the transmit mode. Costs under $400.

Axlon, Inc., 170 N. Wolfe Road, Sunnyvale, CA 94086. Reader Service number 499.

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The Xitex XM800S microcomputer features a Z-80 CPU, Mostek STD bus cards in a 16-slot card cage, dual eight-inch drives and CP/M 2.2 operating system. The XM800S has an all-metal enclosure that can be configured for standard 19-inch rack mounting or desk top use. Price is $4045.

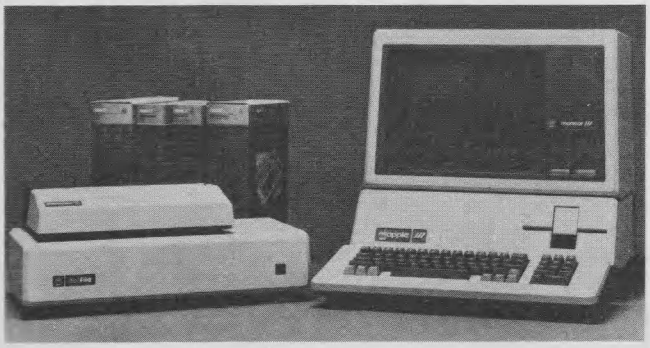
Xitex Corp., 9861 Chartwell Drive, Dallas, TX 75243. Reader Service number 498.

Apple III Upgrade

A more powerful Apple III, with expanded mass-storage capability and professional application programs, is offered by Apple Computer Inc., 10260 Bandley Drive, Cupertino, CA 95014. The new Apple III features an improved operating system, more reliable hardware and seven new or enhanced software packages. In addition, Apple III supports up to 256K bytes of internal memory. The expanded storage capability is provided by the new Apple III/ProFile personal mass-storage system, a 5M-byte hard-disk system. Reader Service number 496.

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The JBE speech synthesizer is designed to plug into the Apple II. It uses the Votrax SC-01 phoneme speech synthesizer chip. This single chip phonetically synthesizes continuous speech of unlimited vocabulary from low data rates. The SC-01 speech synthesizer contains 64 different phonemes and four pitch levels that are accessed by an eight-bit code. This board has an amplifier that directly connects to an 8 ohm speaker. A disk of sample programs is in-



The new Apple III has an improved DOS and more memory.

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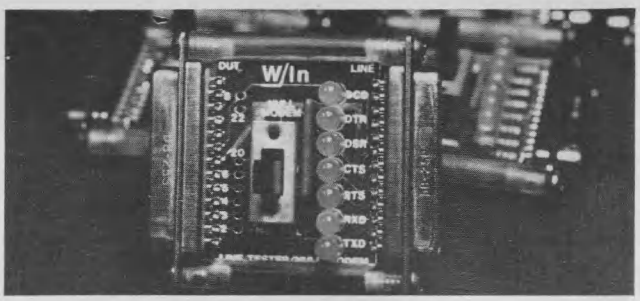
cluded. The speech synthesizer costs $139.95.

John Bell Engineering, Inc., PO Box 338, Redwood City, CA 94063. Reader Service number 495.

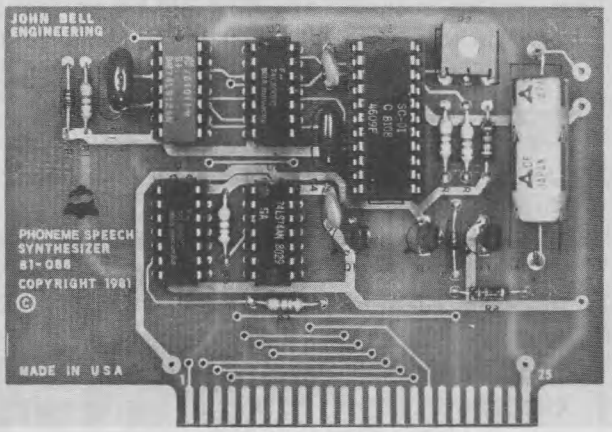
Test Device

Anyone who has interconnected terminals, printers, modems and microcomputers knows the frustration of finding out why certain hookups don't work. A frequent solution is to measure the voltages on the connector pins with a multimeter and rewire the cables until the system works. The W-DLT (data line tester) is a portable device that will identify the seven most commonly used RS-232 data lines and show the likely cause of the problem. The flip of a switch converts the tester to a null modem, used to connect two terminals, modems or micros without rewiring any cables. This lets any standard device communicate with other devices with one standard type of cable. The W-DLT costs $59.95, Canadian.

Warren Instrotech Ltd., PO Box 5739, Station F, Ottawa, Ontario, Canada K2C 3M1. Reader Service number 493.



The W-DLT data line tester from Warren Instrotech.



John Bell Engineering's plug-in speech synthesizer board.

Daisywheel Forms Handling

Olivetti has introduced two serial daisywheel printers with automated paper insertion. Both printers offer bidirectional printing and a fully motorized feeding mechanism that loads up to 200 sheets and automatically recovers and reverses stacking. The DY 211/ASF is a 20 cps unit, priced at $2350. The DY 311/ASF prints 34 cps and sells for $2870.

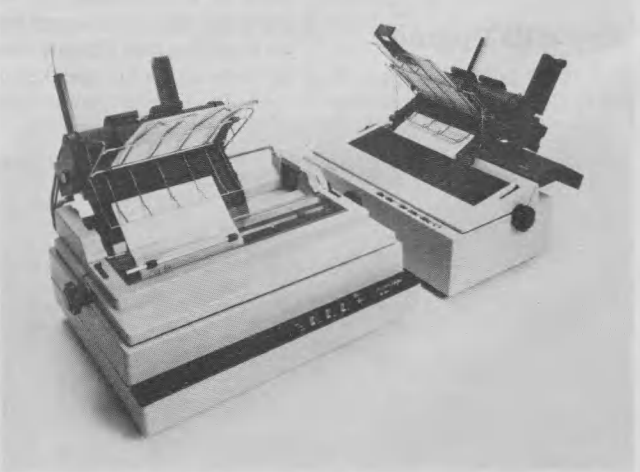
Olivetti OPE, 505 White Plains Road, Tarrytown, NY 10591. Reader Service number 492.

Bus Controller Enhancements

SSM Microcomputer Products, Inc., 2190 Paragon Drive, San Jose, CA 95131, has announced firmware enhancements for its A488, a plug-in card that turns the Apple II into an IEEE 488 bus controller. The Version 2.0 firmware includes secondary addressing, binary data transfer and bus timeout. It also has quiet controller capability, which permits two or more devices on the bus to communicate without bus-controller intervention. Optional software drivers are now available on disk for Pascal and FORTRAN. Price is $475. Reader Service number 494.

Color Video RGB Monitor

Panasonic has an advanced color video monitor for use with microcomputers. The Model CT-1350MG features selectable AFC constants for normal or VTR use and a



These two daisywheel printers from Olivetti offer automated paper insertion.

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- Tax Computation
- Document Cross Referencing
- Legal Office Accounting
- Scheduling
- Mailing Labels
- Calendar Events

If your application calls for managing data, dBASE II may be the answer.

You can create a database and start entering data into it in less than a minute.

Type CREATE, then respond to the dBASE II prompts to name the file and define the fields in your records.

Once the record is defined, you can start entering data immediately, or add information later by typing APPEND. In both cases, dBASE presents you with an entire record structure for which you simply fill in some or all of the blanks.

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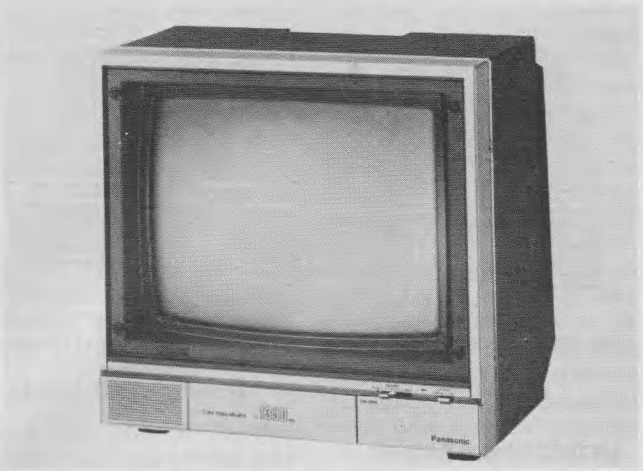
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Panasonic Video Systems Division, 1 Panasonic Way, Secaucus, NJ 07094. Reader Service number 491.

Upgraded Single-Board Micro

The new SYM-2 single-board microcomputer is available from Synertek Systems, PO Box 552, MS 61, Santa Clara, CA 95052. The board includes an on-board power supply, choice of microprocessors (6502, 6809 or 6802), cassette interface jacks, eight toggle switches for user input and eight LEDs for user output. Software compatibility between the SYM-1 and the new SYM-2 has been maintained. The expansion and application ports are also compatible with the SYM-1, so that expansion devices such as RAM or the new FDC-1 floppy disk controller are interchangeable between the SYM-1 and SYM-2. Price is $249. Reader Service number 490.

Multi-User Micro

Altos Computer Systems, 2360 Bering Drive, San Jose, CA 95131, is introducing 16-bit microcomputers that are compatible with a variety of operating systems and business application programs. Up to eight users can share the 8086-based ACS8600 systems, which also use an 8089 for DMA and I/O and optional 8087 for fast floating-point arithmetic. Floppy and Winchester hard-disks provide storage of 1 to 80 megabytes. The new systems feature error detection and correction and a unique memory management system that maps memory in high-speed RAM. The systems support four operating systems, including the powerful XENIX system, Microsoft's adaptation of UNIX, supporting communications via UNET. The ACS8600 systems also support CP/M-86, MP/M-86 and Oasis-16 operating systems. This permits applications in Microsoft versions of BASIC, COBOL, Pascal and FORTRAN, as well as CIS-COBOL, RM-COBOL, Pascal/M-86, C-BASIC-86 and C.

The basic system with 128K bytes of main memory, dual floppy storage of 1M byte and no hard disk costs $8990. The same system with 512K bytes, a 10M-byte hard disk and floppy disk backup costs $12,990. Reader Service number 489.

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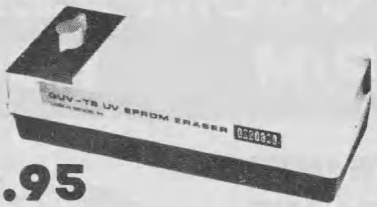
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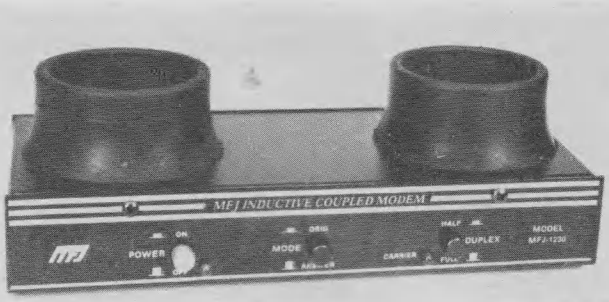
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Business System

The Victor 9000 16-bit microcomputer system comes standard with 128K bytes of memory and is internally expandable to 256K or 512K. Disk capacity is 1.2M bytes. The Victor 9000 includes a detachable keyboard with a user-defined function key to simplify program operation and a standard numeric pad. The CRT tilts and swivels for comfortable viewing. The dual-format



The Victor 9000 128K-byte micro.

screen displays 80 characters × 25 lines in normal format and 132 characters × 50 lines in expanded format. The screen simultaneously displays high-resolution graphics, bar charts, pie charts, diagrams and schematics. Price is $4995.

Victor Business Products, Kidde, Inc., 3900 North Rockwell St., Chicago, IL 60618. Reader Service number 488.

Multi-User Micro

A low-cost business microcomputer that features up to 16M bytes of on-line Winchester hard-disk storage is now available from Dynabyte, 521 Cottonwood Drive, Milpitas, CA 95035. The Dynabyte 5505 will accommodate up to eight users and 16 printers. Since it uses the CP/M operating system, a wide range of languages and more than 300 application programs are available to run on the system. The 5505-A1 with 6M bytes of hard-disk capacity is priced at $6995; a 10M version sells for $7695 and the 16M version is $8495. Reader Service number 484.



The Dynabyte 5505, a multi-user table-top microcomputer.

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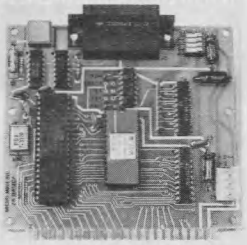
Program also carries out computations for depreciation schedules, joint vs. separate returns, itemized vs. standard deductions, depreciation vs. tax credits, etc., in order to help make important tax decisions. Includes 1981 Tax law changes, references to related areas such as gift and inheritance taxes, trusts, estates, partnerships, corporations, pension and retirement plans, tax-exempt organizations, etc. Includes booklet of useful IRS tax forms, other tax publications, and toll-free phone number of tax attorney. Available on cassette or diskettes for most popular micros. Price $49.95

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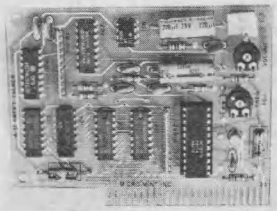
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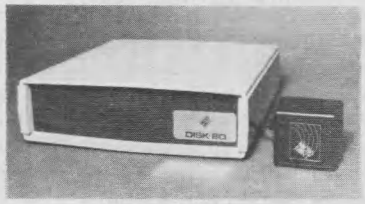
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VolksMicro Computer Systems, Inc., 202 Packets Court, Suite C, Williamsburg, VA 23185. Reader Service number 466.

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InfoStar is an application development tool for both novice and experienced computer users. This report generator/file processor for CP/M-based micros lets you produce business reports and tailor existing applications programs without the help of a programmer. Just specify the format of the data and InfoStar will write the code. InfoStar can query a collection of files, print information based on the data in the files in a format designed by the user and update or open new files based on the data it has processed. The program can operate simultaneously across multiple files. InfoStar is intended to be used with MicroPro's DataStar data entry program. InfoStar costs under $1000.

MicroPro, 1299 Fourth St., San Rafael, CA 94901. Reader Service number 467.

Down on the Farm

American Small Business Computers, 118 South Mill St., Pryor, OK 74361, is offering the Farm and Ranch Management series. The 13 programs in the series were developed by Oklahoma State University division of Agriculture, and run on TRS-80 Models I, II and III. Programs are available to simulate feeding situations for beef cattle, evaluate energy, protein, calcium and phosphorus content of ration, compare participation with non-participation in government wheat-feed grain-cotton programs, compute the cost per bushel for on-farm grain storage and even to calculate anticipated Oklahoma and Federal estate taxes. Prices range from $15–$35. Reader Service number 468.

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Earthquake Country Software's High-Level Applications Language (HAL) system will remember what you want to remember. If you need to store a new type of document, tell HAL what the data looks like and the system will create a custom filing system for this new document. Or if you want several ways of displaying the documents for reference, tell HAL how you want the reports to appear. The system asks for the information it needs to set up the files, remember the data and write your reports. You converse with the system in simple English (or German or French or . . .). If your language isn't simple, the system will learn your vocabulary. Built-in modules include relational database manager, transaction analyzer and data dictionary controller. All commands are menu-driven or self-prompting, and the system is self-documenting.

Earthquake Country Software, 18771 Blythswood Drive, Los Gatos, CA 95030. Reader Service number 469.

PET Navigator

An air navigational aid is available to pilots for use on the Commodore PET/CBM microcomputer. RNAV3 Navigator obtains true straight-line courses for aircraft having DME equipment and VOR-to-VOR courses for aircraft without the DME ability. It performs hundreds of trigonometric functions per flight, handles the spherical nature of the earth (polar coordinates) and always searches for the closest radio signal while the flight path is being calculated. The pilot provides only four items: flight option, waypoint interval (if DME is used), departure coordinates and destination coordinates. The resulting calculated flight path is then displayed and/or sent to a printer. Each waypoint of the flight contains the closest VORTAC code name, radio frequency, radial and distance from path. Each point also displays the magnetic compass bearing, nautical miles traveled and miles left to complete.

The program comes in two versions. One fits within the 8K PET, covers the three Pacific states, Idaho, Nevada and Arizona, and costs $25. A 16K version covers the eleven continental states west of the 102nd Meridian, and costs $30.

Briley Software, Box 2913,

Livermore, CA 94550. Reader Service number 470.

PET Utility

The PET/CBM Cross Reference program is similar to cross reference programs found on many larger computers, with several significant additions. Cross reference programs show program structure by displaying line numbers that are GOTOed or GOSUBed to from other lines in the program, and listing the line numbers in which different variables appear. The user simply enters the program name, the desired listing format and the presence of special software commands (such as those used by Superkram). The program will first provide a formatted listing of the program, followed by a line number cross reference, a variable cross reference and, finally, program optimization statistics. Price is $29.95.

Oppenheimer Software, 79 St. Boat Basin, #39, New York, NY 10024. Reader Service number 471.

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The Meta-Market system is a complete marketing package. An unlimited number of clients can be stored, and each client can have five employees, associates or family members cross-referenced. The system tracks status codes, prospecting codes, marketing codes and birthdates, and prepares lists, labels and letters. The software runs on the IBM personal computer with 64K bytes of memory, twin disk drives and any 80-column or larger printer. The system is written in IBM advanced BASIC and requires the IBM DOS for support.

Metamorphics, Inc., 154 Montgomery Ave., Bala Cynwyd, PA 19004. Reader Service number 472.

Small-Business Forecasting

Business Planner, a modeling package for entrepreneurs starting or expanding a small business, is available from Duosoft Corp., Box 1827, Champaign, IL 61820. The program groups labor, equipment and other costs into income-related projects, helping you design and develop sound business plans. Projects are combined into a model that generates graphic projections and estimated financial statements. By exploring alternate models you can evaluate critical timing and resource allocation decisions. You can compare actual results with the model to focus attention on problems that might hurt future performance. Business Planner is now available for the Apple II and III, for $297.50. Reader Service number 473.

Land Mobile Support

Front Range Communications, Inc., Box 12010, Boulder, CO 80303, is introducing a line of computer products for the land mobile and related industries. The EMI (electro-magnetic interference) intermod program predicts radio frequency interference possibilities at radio communications sites. The program will find and define intermodulation products to the ninth order for two and three transmitter combinations, and harmonic combinations to the sixth order. It reports products within the passband of the co-located receivers, and accepts variable bandwidths and up to 100 transmitters and 100 receivers. The program will create a disk file report of the findings and will print and format a written report.

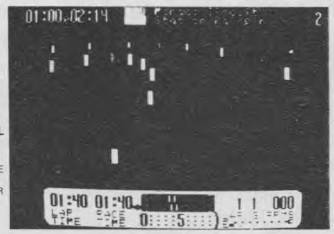
Horizon is an interactive program that gives the communications engineer path loss information on VHF and UHF radio paths. Enter the geographic coordinates, frequency, antenna gain, feed line loss and K factor. Horizon tells you the distance, direction, path loss and antenna height required. If you enter bandwidth and power it will give required receiver sensitivity. If you enter antenna height it will give you distance to radio horizon. The programs require CP/M, disk drive, Z-80 CPU with 48K bytes memory. Priced at

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MBA Software, Inc., 270 Sunkist Lane, Los Altos, CA 94022. Reader Service number 476.

APL Interpreter

Three versions of TIS-APL are now available for the North Star microcomputer, on disk configured for double- or quad-density, 56K or 64K of memory. Version 1, for educational uses, contains all the primitive APL features and costs $295, U.S. Version 2, the software development version, contains the APL primitives and all the file-handling and editing features of APL; it costs $495, U.S. The Version 3 contains all the features of Version 2, plus future updates and enhancements to APL at no charge and complete access to Telecompute's user-inquiry service; cost is $1195, U.S.

Telecompute Integrated Systems, Inc., 251 Spadina Ave., Toronto, Ontario, Canada M5T 2E2. Reader Service number 481.

Language Tutor

The Micro-Deutsch set includes 24 grammar lessons, covering all material of an introductory German course. Four test units are also included. Grammar lessons use substitution transformation drills, item ordering, translating and verb drills. Drill vocabulary is based on use frequency lists. Micro-Deutsch is suitable for use with any high school or college introductory text. The program runs on Apple and PET microcomputers. The PET version includes a special foreign language character chip. Price is $179, on disk or cassette.

Krell Software, 21 Millbrook Drive, Stony Brook, NY 11790. Reader Service number 478.

OSI Screen Editor

Edit All is a full screen editor for OSI computers from DMP Systems, 319 Hampton Blvd., Rochester, NY 14612. It replaces the standard I/O routines to allow the user to edit any program line that is on the screen. As editing takes place, the line is dynamically expanded or contracted. Edit All supports a scroll window screen handler that lets you define where on the screen you want your output to go. The window's length, height and width are user-controlled. Full cursor control and instant screen clear are included. Edit All works with OS65D BASIC and assembly language. Price is $19.95, on disk. Reader Service number 475.

Medical System for Apple

Comma is a medical management system for practices of up to nine doctors. It features total accounts receivable control with variable period aging reports, delinquency notices, daily cash reports, statements, journal and day sheet. Patient accounts can be entered as families or individuals, and can be displayed at any time to review current balance and correct aging balances. Comma provides insurance forms handling with AMA, Blue Cross, Blue Shield, Medicare, Medicaid, Medi-Cal and Champus forms, printed for interim or period-to-date transactions. Itemized Super Bill/universal claim form can be printed at time of service or later. Practice management features include daily and period-to-date reporting of services performed, by doctor and practice and period-to-date diagnosis analysis. Comma also features a recall appointment scheduler with recall report, mailing notices and labels. The minimum hardware requirements are Apple II+ with 48K bytes memory, 24 x 80 video card, three mini-floppy drives and 80-column printer. Price is $1495.

Spectra/Soft, Inc., PO Box 277, Chandler, AZ 85224. Reader Service number 482.

Centronics 739 Graphics

Centronics Data Computer Corp., Hudson, NH 03051, has announced the availability of three new software packages designed to support the Model 739 graphics printer.

A graphics driver, Enhanced Graphics Software from Computer Station of St. Louis, MO, allows printing of the Apple's hi-res screen. Price for the graphics driver is $44.95.

Graphtrix, by Data Transforms, Inc., of Denver, CO, is a graphics screen dump and a text formatting program that adds graphics, footnotes and chapter capabilities to the Apple Writer text editing system. Functions such as magnification, normal/inverse, page centering and titles can be accessed with a single Applesoft command. Price is $65.

NewScript is a word processing package designed for use with the TRS-80 Models I and III. NewScript supports right margin justification of text, all character fonts, superscripts and subscripts, double-width characters and underlining. Priced at $99.95. Reader Service number 477.

Energy System Design

Energy is a series of programs for design calculation of heating and cooling loads on a room-by-room basis with totals for zones and total building. Energy consists of three main modules for data input, calculation and output. There are also overlays and several auxiliary modules. The inputs are basic building data followed, in any sequence, by partitions, exterior walls, floor, roof, glass, doors and room data. Vertical surfaces may face in any of eight directions. The calculations are based on ASHRAE *Fundamentals*, and use the CLTD method of determining hourly loads, allowing for thermal delay by using specific heat, density, K and position of the insulation within the surface. The price is $1000.

W.E. Monks & Co., 3073 North High St., Columbus, OH 43202. Reader Service number 479.

Business Packages for TI 99/4

Three new small-business applications for the TI 99/4 microcomputer are offered by Creative Discount Software, 256 South Robertson, Suite 2156, Beverly Hills, CA 90211. The applications packages include a VisiCalc-like spreadsheet program, a small business payroll system and a financial management program. The new spreadsheet program, called BDB, allows TI users to create spreadsheets with alphabetic and numeric data to general financial forecasts and pro forma income statements. The system will create databases up to 80K bytes.

The payroll system can handle up to 100 employees, and will automatically compute payrolls for weekly, bi-monthly or monthly employees. The system provides complete audit trail and reports for monthly payments, quarterly reports and W-2 preparation.

The project management system lets the user define custom charts of accounts, fix budgets, accumulate costs and estimate fund requirements. The system also provides management displays and reports to keep budgets on target. The three packages each cost $80. Reader Service number 480.

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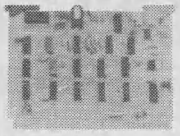
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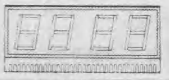


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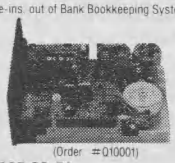


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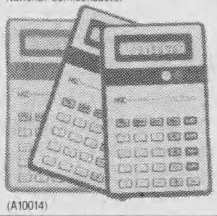


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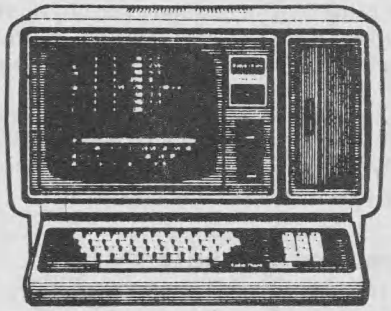
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CALENDAR

Computer Swap America

Computer Swap America, a high technology flea market, will be held Feb. 6, at the Orange County Fairgrounds in Costa Mesa, CA, and on April 24 at the Santa Clara County Fairgrounds in San Jose, CA. Both shows will be held from 10 AM to 6 PM. Admission is $3.

For further information contact Computer Swap America, PO Box 52, Palo Alto, CA 94302. 415-494-6862.

Delaware Computer Faire

The fourth annual Delaware Computer Faire will be held March 6 from 8:30 AM to 3:30 PM at Delaware State College in Dover, DE. The Faire is planned for K-12 teachers, administrators and parents who want information on the classroom use of computers.

The program will include a computer programming contest, a calculator contest, workshops and demonstrations of computer use in the classroom.

For more information contact William J. Geppert, State Supervisor, Mathematics, Dept. of Public Instruction, Townsend Building, PO Box 1402, Dover, DE 19901. 302-736-4885.

The Fifth Annual Computers in Education Conference

The fifth annual Computers in Education Conference will be held at Seattle Pacific University, Seattle, WA, on March 12 and 13. The two day program will have seven concurrent talks, workshops and discussions at each session. Special emphasis will be on the use of microcomputers in the K-12 curriculum.

For further information contact Tony Jongejan, Everett H.S., Everett, WA 98201.

North American Computer Othello Championship

The North American Computer Othello Championship will be held May 15 and 16 at the Learning Resources Center, Andersen Hall, Northwestern University, Evanston, IL. The two day tournament will be held to identify computer champions in three categories: microcomputer systems (located on site), mainframe systems (telephone hookup) and special-purpose Othello machines.

To enter and/or receive information about tournament rules and lodging write to Professor Peter W. Frey, Department of Psychology, Northwestern University, Evanston, IL 60201.

Charlotte Hamfest and Computerfair

The 1982 Charlotte Hamfest and Computerfair will be held March 20–21 at the Charlotte Civic Center, Charlotte, NC.

For more information contact Lane Tarleton, 800-845-6183.

Tutorial Week East

Tutorial Week East, sponsored by the IEEE Computer Society, will be held in Orlando, FL, on March 22–26. It will include 15 tutorials in three different areas: VLSI, microprocessor interfacing techniques and graphics; software design, analysis and techniques; and data communications, computer networking and databases.

For registration information contact Tutorial Week East '82, PO Box 639, Silver Spring, MD 20901. 301-589-3386.

Southcon/82

The Southcon/82 show and convention will be held in Orlando, FL, March 23–25.

For more information contact Robert Myers, 213-475-4571.

Computer Hobbyists And Amateur Radio Convention

Gateway Amateur Radio Association is sponsoring a computer hobbyist and radio amateur convention at the Chase Park-Plaza Hotel in St. Louis, MO, March 27 and 28.

For more information contact GARA, PO Box 8432, St. Louis, MO 63132. 314-361-4965.

Infocom '82

The IEEE Computer Society and the IEEE Communications Society will hold their first annual joint conference, Infocom '82, in Las Vegas, NV, March 30 to April 1. The theme of the conference is "Data Processing—Data Communications: The Illusory Boundary."

For information on exhibiting or a copy of the advance program for INFOCOM '82, write to Infocom '82, PO Box 639, Silver Spring, MD 20901. 301-589-3386.

Eighty/Apple Computer Show

The Eighty/Apple Computer Show will be held April 2–4 at the NY Statler Hotel in New York City. The show is an exposition of products and services oriented to the TRS-80 and Apple computer systems and will feature over 100 exhibitors of hardware, software, books, magazines, supplies, services and accessories.

For more information contact Kengore Corp., 3001 Route 27, Franklin Park, NJ 08823. 201-297-2526.

New York Computer Show and Office Equipment Exposition

The New York Computer Show and Office Equipment Exposition will be held at the Nassau Coliseum in Uniondale, Long Island, April 22 through 25. Show hours are 10 AM to 6 PM. Admission is $5 for adults and $3 for children ten years of age and under.

For further information contact National Computer Shows, 824 Boylston St., Chestnut Hill, MA 02167. 617-739-2000.

IEEE Computer Society Expands Tutorial Week Series to Europe

The IEEE Computer Society's highly successful Tutorial Week Series will be held April 24–28 in Hanover, Germany, concurrently with the Hanover Fair, the largest scientific and industrial exhibit in the world.

Registration fees for Tutorial Week Europe are $140 per day for non-IEEE Computer Society members, and $125 for members.

For program information write to Tutorial Week Europe, PO Box 639, Silver Spring, MD 20901.

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You, too, can have
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Unlike the original Three Mile Island, this Muse program is an excellent product.

TMI was obviously prepared by someone who took the time to gain a good knowledge of nuclear power generation. The result is a program that is both exciting and informative.

TMI runs on an Apple II or an Apple II Plus. It operates well on either a color or black and white screen.

The object of TMI is to operate the plant at a profit and avoid mechanical failures that could result in a meltdown. If you lose too much money, the Nuclear Regulatory Commission closes the plant. If you don't monitor and maintain the systems carefully, you wind up bathed in radiation glow.

The program has eight displays. Four are graphic representations of different parts of the power plant, while four display plant status and operating data. Built into the program are maintenance schedules for all pumps, valves and turbines. Also included is a random failure factor on all parts. An increase in core temperature increases the failure rate of all the plant parts.

The demand for electricity also varies. As the demand increases, you must place more turbines on line to avoid a brownout, and thus a loss of money. This, of course, increases the stress on the plant's systems, forcing the user to be more diligent in his maintenance.

The program uses a boiling water reactor (BWR). Cooling is done by a triple-loop closed system. A closed primary cooling loop operates in the containment building. Heat from this system is exchanged to the turbine loop through a steamer located in the reactor building. The water that passes through the turbines is exchanged with the cooling tower loop in the condenser.

As long as all remains well within each loop system, proper cooling is maintained. However, if a pump in the turbine loop fails, the flow of coolant to the reactor building loop may be interrupted, thus creating a rise in the core temperature and the need for more coolant. The ramifications of a pump or valve failure, particularly as the temperature rises and more valves and pumps fail, can be a fascinating challenge to the operator. Correction of equipment failures is possible but it takes a lot of effort and skill.

The user calls the video displays by typing the symbols 0 through 8. Zero displays the containment building. The graphics of the containment building show the three pumps of the primary cooling system and the three pumps of the emergency core cooling system. Seven values are also displayed in this view.

View 1 displays the four turbines, three filters and their cleaning system, the emergency secondary cooling system with three pumps, the cooling tower and loop with its three pumps and an assortment of other valves and pumps.

View 2 displays the reactor core. You as operator can raise or lower the reactor control rods. This procedure controls the core temperature. On a color monitor, the reactor core glows a pastel red.

View 3 shows the pump house. Unlike Metropolitan Edison's plant at Three Mile Island, the Muse program rarely has anything happen in the pump house. Occasionally a rare accident will occur in which radioactive water floods the containment building floor and is pumped into the pump house, where radiation from the water may vent into the atmosphere. This aspect of the program is just like the real thing.

Views 4, 5 and 6 display the maintenance schedules, cost analysis and operating status, respectively. The cost analysis is probably the most important display; it shows current electrical demand, the time that demand will change, projected profit and actual profit. If things really go bad for you and your reactor heads inexorably toward meltdown, you can by careful attention to detail and firm maintenance of purpose continue to make profit right up to the meltdown. Unfortunately, in the game, losses cannot be passed on to customers, and the program ends when you lose over $250,000.

TMI has a useful save/reset feature. The exact status of the reactor can be saved by merely pressing 7 from the main menu and accessing view 7. This view directs a series of questions at the operator and allows the operator to assign a name to the saved file.

Operation of this program is easy. Control of the complexities of pumps, valves, turbines and filters is what makes this program so challenging and complicated. Changing the status of a pump from on to off is as simple as typing the pump's identification letter.

Starting the program is also easy; it requires no boot instruction or complex initialization. Simply put the disk into the drive, wait 15 seconds and the program is ready. You can either let the computer automatically bring the plant on line or start the reactor up manually.

As your reactor operates, the program beeps audibly to notify you of changes in status. This feature, annoying to the beginner, becomes a great asset in advising the operator of unseen or undetected problems.

The entire program is tied into a game clock. The clock has two speeds, fast and slow. Initially you have all you can do to control the reactor with the slow clock in operation. Eventually you gain the expertise to handle all reactor exigencies without resorting to a panic stop of the clock. Wouldn't Met Ed have loved that feature?

The fast clock mode is frantic. It is far too fast to allow for the regular maintenance and inspection of the reactor. You

can only respond to the audible notifications of changes in status by stopping the clock and looking for what has happened.

The graphics are the weakest feature of this program. They are by no means poor, but could have been considerably improved. One problem lies with the colors used to display the cooling water of the various loops. It is very difficult to tell whether water is or is not running through the cooling loop. To further complicate matters the designer chose to use different colors for the water in the different loops. This adds to the confusion of trying to tell if water's in the system.

Also, the valves are shown in green when open and red when closed. It should be easy to discern whether they are closed or open, but it isn't. It is easier to tell if a valve is open or closed on a black and white terminal. But this is a problem that you can easily live with.

The documentation on this program is superb. Muse always gives good documentation with their programs and this one is no exception. The instructions are thorough, logical and well organized. No questions that you might have about the program's operation go unanswered. The only weakness in the documentation is again with the graphics. The pictures of the displays are too small to see clearly. They give you no help in learning what the displays look like.

The control and maintenance of a nuclear power plant is a difficult and complex procedure. Three Mile Island by Muse reflects this complexity. It offers challenge and excitement. It is a great deal of fun and is highly recommended as a program that will test your mental faculties. One could hardly ask for more than that from a recreational computer program.

(Muse Software, 330 N. Charles St., Baltimore, MD 21202. $39.95.)

Bruce Stephenson
Keene, NH

VisiTerm

Make communication
A simple chore
For your Apple II

If you have an Apple II and a modem, you can handshake with most other computers and "talk" over telephone lines. Adding VisiTerm to your collection of software will make this kind of communicating simpler and more certain. You will probably find that you can make your computer compatible with any kind of equipment you may want to contact.

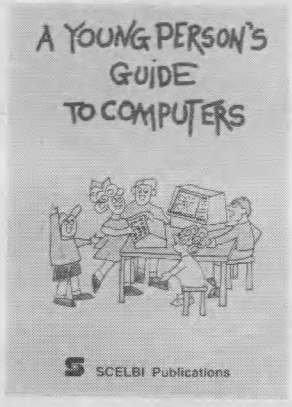
Of all the new members of Personal Software's Visi-family, VisiTerm is by far the most original. It can do for computer communication what VisiCalc did for computer arithmetic.

The following equipment is required for the VisiTerm program: An Apple II or II+, one disk drive, a communications card and modem. An ordinary TV will do, but a monitor is recommended to make use of the hi-res capability. A second disk drive adds little to the system. I used the D.C. Hayes Micromodem II package, which worked without a hitch.

You simply boot VisiTerm and go to the options menu, and you're ready to dial out or receive data. In the terminal mode an up to 70-character per line high-resolution display is generated without extra hardware. You can design your own characters or use any one of 12 sets, including APL symbols, available from the program. This system is so intriguing, I regretted that a screen save and/or dump is not provided. (With these copy-protected programs it isn't possible to enter one.)

You are automatically put into half-duplex mode, but a two-key command changes this to full duplex. You can change the latter two conditions while sending or receiving. VT also generates upper/lowercase, and the shift key modification is supported. A type ahead buffer is provided, which comes in handy when the receiving party puts you on hold.

VisiTerm allows such a wide range of protocols for sending and receiving text that it is difficult to imagine a set of circumstances where you would be unable



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progressive computing

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"I have nothing but contempt
for anyone who can
only spell a word one way."

to communicate. (Here I am assuming that equipment at both ends of the line is functioning properly.) For purposes of this review I dialed successfully into TRS-80, Atari and Commodore systems as well as Apple's. I communicated briefly with the University of Washington's mainframes, where off-campus college courses are available.

Designing your own characters can be useful when receiving data. For instance, VT lets you make the bell ring, with three levels of loudness, whenever a certain character is sent or received. Control characters can be visible if desired.

Any text file can be sent out from the File Transfer mode. This means that VisiCalc files of any length can be loaded and sent without conversion to the DIF (data interchange format). The same holds true for DeskTop Plan II and VisiPlot/VisiTrend files. File transfer is speeded up considerably. Not having to do anything to the data before transmission avoids errors.

Handy utilities also facilitate file transfer. You can convert Applesoft, integer and binary files to text files. Text files can be converted to binary files—very convenient.

Frequently-used key sequences can be redefined with Keyboard Macros. Since carriage return and line feed don't always happen with a single keystroke, I found it handy to redefine the semicolon for that. I made the colon type my full name, address and telephone number.

In the receive mode you can specify the number of rings before the computer picks up the telephone. In file transfer mode the incoming message can automatically be saved for playback at a later time. VisiCalc, VisiPlot, VisiTerm and DeskTop Plan II files can be transferred directly into your programs after saving on disk.

Dialing has to be done slowly and deliberately. Only one digit at a time will be stored in memory. The slow dial is required by the modem. However, it would seem to me that the VT program could easily have dialed for you from a personal telephone directory, if such a directory was included in the system. It is not. Everything else seems to have been thought of.

Documentation comes in the by-now-familiar brown eight by ten ring-binder. The user's guide consists of an introduction, three tutorial lessons, a reference chapter, a detailed appendix and a complete index. The manual is well-written and easy to understand.

VisiTerm retails for $149. A backup copy of the disk can be purchased for $30 (not cheap). Replacement disks for registered owners are $20.

(Personal Software, Inc., 1330 Bordeaux Drive, Sunnyvale, CA 94086.)

G. R. Brieger
Redmond, WA

Word

A CP/M-based program
To help your computer
Help you spell

I've always had a fondness for Thomas Jefferson. Anyone who wrote the Bill of Rights and said "I have nothing but contempt for anyone who can only spell a word one way" can't be all bad.

Jefferson and I would have gotten along just fine—I'm an awful speller. I'm so bad that I don't even know when a word is spelled correctly. Ninety percent of the words I take the time to look up (and I do mean time: I'm lousy at alphabetical order, too) are right in the first place. It's discouraging. Thus, the deciding factor in buying a computer with word processing capabilities was the flurry of programs promising to forever end the Curse of Noah Webster. (He's the one who started it all, you know. He's the one who came along 198 years ago and gave us only one way to spell a word. The right way. His way.)

In my research, I came across a bit of dictionary software that not only does more than any of the others I've read about, but costs less. Far less, in fact.

Word retails for $75. (Spellguard is $295. Others run in the $150–250 range.) "The first question people ask me," says the creator of Word, Wayne Holder, " is 'What's wrong with it? Why is it so cheap?' " Thus far I've found nothing "wrong," and a good deal right, with it.

The dictionary in Word is massive—more than 45,000 words. (Other software seems to be in the 20,000-word range.) The dictionary is compressed, allowing that many words, plus all other programs and commands, to fit into less than 176K of disk space. (The dictionary uses almost 160K of that.)

Word will do what all the other "dictionary" programs will do: check each word in the text against the correctly spelled words in the dictionary; list words that do not match (indicating misspellings, typos, uncommon proper names, jargon or technical terms); and then, after the option to edit the list by the user, mark the mismatched words in the text for correction.

It is at this point that Word uses a program descriptively labeled LOOKUP, a tool that, from my point of view, is worth far more than $75 all by itself. One simply types "LOOKUP" and the way one *thinks* the word should be spelled, and LOOKUP will, nine times out of ten, find the correct spelling. (I misspelled 12 words when writing this article and



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Item B	**45,671**	**46,128**	**49,088**	3.67	46,962	140.89	50,891	52,761	58,791
Total	87,994	98,019	114,211	13.93	100,075	300.22	131,673	152,966	250,053
% Item	48.10	52.94	57.02	8.88	52.69	158.1	61.35	65.51	76.49
% Item	51.90	47.06	42.98	-9.00	47.31	141.9	38.65	34.49	23.51
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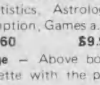
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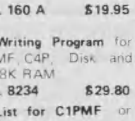
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LOOKUP found the acceptable-to-Mr. Webster spelling for 11 of them.) It does this, I am told, by "correcting" the word in a great many ways, using the four most common mistakes in spelling, checking these "corrections" against the main dictionary, and listing the words that match. If I were to ask it to LOOKUP THIER, for example, it would list THEIR, THIEF and TIER. I may be bad at spelling, but of the three I can tell the word I'm looking for is THEIR.

Another fascinating feature of Word, indispensable to crossword puzzle fanatics (who don't mind a little help) and writers who need to rhyme (who welcome all the help they can get) is FIND. Based upon the number of letters known, with "?" or "*" for the letters unknown, FIND will find all the words that might fit.

If you were doing a crossword puzzle and you needed a four-letter word that ended in "Q," all you'd need do is type "FIND ???Q" (each "?" represents one letter) and in less than a minute FIND would tell you that the word you're most likely looking for is "IRAQ."

If you were writing an "Ode to My Computer" and were looking for a melodic match for "terminal," all you'd need do to find more than enough rhymes is enter "FIND *AL" ("*" represents any number of letters) and all words, of any length, ending in "*AL" would come flooding forth (as a poet might say). This would give a near-endless list of words. To tighten the rhyme you might want to remove just the first letter and enter "FIND *ERMINAL". This yields only one possibility, GERMINAL. So you might want to loosen the rhyme a bit and, say, leave off the first syllable, entering "FIND *MINAL". This brings forth from the depths of iron oxide such gems as CRIMINAL, NOMINAL and SEMINAL, among others.

Three more great tools for the writer included in Word are Wordcount (WC), Word Frequency (WORDFREQ) and Dictionary Sort (DICTSORT). There were 1297 words in the original draft of this article. It took Wordcount about three seconds to give me that information. (Can you imagine how long it would have taken me to give me that information?) Word Frequency tells how many times each of these words was used, and will list them either in descending order of usage or alphabetically. The Top Ten words in the original version were: the (used 65 times), of (29), and (also 29), I, word, a (28 times each), in (26), to (25), that (19) and is (18). (Suprisingly, the word spelling was used but six times, spelled three and spell only twice.)

DICTSORT is a program that will put any group of words in alphabetical order within seconds. If it puts one index of one book in order, it's paid for itself. It's also great for mailing lists and record collections (mine is: Popular, alphabetical by artist; Classical, alphabetical by composer). Or, if you're more like Daniel Webster than Noah Webster, it will put your book of "Alternative Spellings For Free Americans" in perfect order faster than you can say "Life, liberty and the pursuit of happiness."

The drawback of Word is the obvious one: it needs a disk capacity of at least 176K, which a great many micros do not yet have. (I am told that a 20,000-word version is on the way that will fit single-density 5¼-inch systems). Word is currently available on a single-density eight-inch disk. I had no trouble having that copied to a quad-density five-inch North Star format, and it works fine. (I am told the 45,000-word version of Word will be sold on five-inch disks for North Star, Superbrain and other double-density systems in the near future.) Word uses CP/M 1.4 or 2.2 and will work on Radio Shack Model II if it has been fitted with CP/M. Word is compatible with almost all CP/M-based word processing and text editing software.

It's not as easy to add new words to the dictionary as I would like. It requires several steps and I would prefer it to be done in one. On the other hand, it keeps me from automatically adding words that I will never use again, keeping usable disk space useable. (I've combined Word with WordStar and Mail Merge, along with a few of my own boilerplate paragraphs, on one disk and I still have 56K to spare. I use this disk for correspondence, articles or short chapters. I enter text, edit, correct spelling and print, all without changing drives. I then copy the file onto an appropriate storage disk, erase the original, and have 56K again for my next project.)

The 30-page manual is clear, friendly and to the point. It includes all you'll need to know to be working Word within an hour. (Maybe less for you: I'm as bad at reading as I am at spelling.)

I can heartily recommend any of the several programs contained in Word for the $75 price; and when they're all together, in one package, at that same price, well, it's one of the great software bargains around.

(Word, Oasis Systems, 2765 Reynard Way, San Diego, CA 92103.)

Peter A. McWilliams
Los Angeles, CA

ROOTS89

Filling out
The family tree
Was never easier

Six-foot, six-inch George Gibbon, the champion of the Oxland families, armed with a mighty broadsword and clad in rough animal hides, towered over diminutive Albert Bright, the hope of the Re-

gencia clan, at the climactic meeting of the feuding families.

Albert carried no weapon.

The giant raised the broadsword. Tiny Albert reached into the folds of his garment.

That's the situation near the end of the once-upon-a-timer that opens the reference manual for ROOTS89, the new genealogy software package (5¼ or eight-inch disks) for the Heath H-89 or H-8/H-19/H-17, and soon to be available on CP/M.

Offered by Commsoft of Palo Alto, CA, it's a new entrant into the very small field of programs for microcomputerization of genealogy data, and has impressed those familiar with this type of research.

To put the problem that genealogy files present in perspective, Lt. Col. Stanley N. Marker, chairman of the lectures committee and member of the executive committee of the Society of Genealogists in London, England, writes in the preface to the ROOTS89 manual: "One of the prime problems facing the genealogical researcher is the storage, retrieval and display of the voluminous data associated with the research process. Those problems bespeak the utilization of computer technology, and ROOTS89 is here to help."

ROOTS89 puts an entire family tree on a floppy disk, providing a window to look at any branch of that tree. The program automatically keeps track of all the relationships, based on the data entered, and juggles and reports back relationships according to the particular routine called up from the totally menu-driven system.

Record capacity is vital to any genealogical system. In the minimum operating system—32K RAM, one drive, with operating programs and the data basefile on the same disk—ROOTS89 will handle about 500 names and all pertinent data for each name. In a maximum configuration—56K, two drives, with programs on one drive and database file in the second drive—the capacity is more than 1300 names, according to Howard Nurse, President of Commsoft.

Nurse adds, "If your family tree is bigger than that, break it into two data files—mother's side and father's side—and double the effective available size."

Nurse and the program's author, Herbert Drake, Jr., introduced the program in April at the Computer Faire in San Francisco, and found numerous takers at the suggested retail price of $124.95, which includes a remarkable manual.

Drake said, "ROOTS89 is obviously a database management system, but it is based on an unconventional overlay technique. To store the first occurrence of a name—say 'Smith'—the program uses eight to 16 bytes, but then never stores it again. It then uses pointers to keep the Smiths separated. The value of this technique in a database file which calls for repeated use of identical names, is paramount to the system's economical operation."

ROOTS 89 lets you look at any branch of your family tree.

Another major difference between ROOTS89 and other microcomputer genealogical systems is that the program loads the data into memory, rather than accessing data files on disk, and does its work in memory, which speeds the process considerably. Drake explained that the total package is seven overlaid machine-language programs, linked through a main program.

The entire system is turnkey-bootable, soft-keyed and completely self-prompting, with concise menus for each step of the process. The eight function keys of the Heath H-89 are shown across the bottom of the screen, and any available for use in a particular routine or situation are highlighted in reverse video.

Just what the system does is apparent from looking at its major routines.

The Edit routine creates and edits the database file. When entering this, the program displays a comprehensive form to be completed for the named individual, including birthdate, place of birth, deathdate, place of death, sex, father, mother, name of spouse (up to four), place and date of marriage, and a special "flag" entry for key information that doesn't fit the mentioned categories.

The pedigree display in the Trace routine shows all the branches for six generations at one time, and movement around the pedigree tree (through a maximum of 99 generations) is done with the cursor control keys.

The List routine provides a scrollable listing of all names in the file, with the ability to select up to ten names, store them in a temporary buffered scratchpad and then access those names for use in other routines.

Another key routine, Family, shows all the spouses and offspring of any particular individual.

Still another part of the program allows the user to select any two names and have the program report their specific relationship. The relationship program searches up to eight generations and reports relationships according to the standard consanguinity charts. Taking yourself as the subject of such a chart, the program will find the relationship of every-



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one from your sixth great-grandparents to first cousins once removed (who would be contemporaries of your grandchildren).

The Print mode not only outputs standard multiple-page pedigreed charts and family group sheets, but will also provide detailed blank forms for use in field work.

Over dinner, Nurse and Drake discussed conception, gestation and birth of their system. Their comments are particularly instructive about how responsible software authors and publishers get the best possible package to market.

In developing the system, Nurse used his own family as a working model for the database file. Nurse and Drake have been closely associated for many years because of their common interest in amateur radio. Work on ROOTS89 began in early 1980.

"We were comfortable enough with the package by last February to submit it to the Heath Quality Assurance department," Nurse says. "They reported back that it seemed 'a very stable product.'" That's high praise in the sometimes murky software world.

The next step in Nurse's field testing program was submission to a Commsoft panel, which included random H-89 users, a computer library expert and two members of the Church of the Latter-Day Saints, an organization noted for its immaculately detailed and highly computerized genealogical records. ROOTS89 passed the scrutiny of all members of the panel with high marks.

The final test was what Nurse calls the "computer tyro" test. Bruce Murray, a professional writer but not a computer expert, was commissioned to take Drake's draft manual, learn the system and write a final manual.

"The idea was to produce a clear and professional manual that was not filled with buzzwords, or presupposed knowledge. Having a professional writer involved at that stage was vital," Nurse insisted.

The result is an entertaining, educational and direct 88-page manual. Fully 40 pages of that manual deal with the science of genealogy, and not with ROOTS89. Almost anyone can get a working knowledge of genealogy and a running start on compiling his own family tree from scratch with the directions in that section.

"There's no reason why a manual shouldn't be educational in a topic, as well as instructive in how to exercise the computer," Nurse says. The Gibbon and Bright families make up the demonstration basefile.

But back to the giant and little Albert. As Gibbon was about to cleave the champion of the Regencia family in two, tiny Albert held out a parchment. It was a genealogical chart. The giant paused and examined the document.

He laid aside his sword and said, "Cousin Al, why didn't you say it was you?" Peace reigned.

(ROOTS89, Commsoft, 655 Maybell Ave, Palo Alto, CA 94306)

Edgar F. Coudal
Park Ridge, IL

Castle Wolfenstein

Questionable themes: A game program That likes to kill

Castle Wolfenstein represents everything that is good and bad about microcomputer adventure games.

On one hand, it calls for an ideal blend of strategy, quick reflexes and fast thinking. The program's structure and graphics ensure that the game will remain interesting after repeated plays.

On the other hand, the theme of Castle Wolfenstein rests somewhere between questionable and reprehensible. If this were a Saturday morning kiddie show, it wouldn't last five minutes, and any parent who buys this program should check it out carefully before letting his or her child play it.

Castle Wolfenstein, the documentation

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says, is a Nazi headquarters in which the player awaits interrogation and torture by the SS. The object is to escape the castle, preferably with the war plans if you you can find them. You're given a gun and ten bullets, and in the process of fleeing from chamber to chamber can acquire such objects as a uniform, a bullet-proof vest, grenades and more bullets.

Naturally, you meet with lots of Nazis along the way, who are understandably hostile. You have two options: you can try to sneak by them or you can blow them away.

Unfortunately, the latter is far more convenient. In fact, sneaking from one chamber to another mopping up Nazis can become a game in itself.

Most of the guards aren't too bright. You can wait for them to walk right up to you and then pull out your gun and shoot them. Or you can sneak up behind them and shoot them in the back. It's especially fun to waste them with a grenade—they turn into vapor right before your eyes.

In some cases, the game actually encourages you to kill the little Krauts. For instance, a guard will sometimes surrender, and can hence be searched. Once the search is complete, you can let him go—but he'll immediately start chasing you again. It's much easier to simply shoot him where he stands.

I don't care if it is just a little green figure on my computer screen. I have problems gunning down someone with his hands in the air.

A spokesman for Muse says that author Silas Warner might give the player another option in later versions of the program. But the central problem remains: the program revels in death and violence.

The problem is amplified by the fact that the program presents the user with a realistic situation. These aren't globs of sinister ectoplasm from the far reaches of space; these are human beings, who can even be identified by nationality. The fact that they are Nazis—and therefore the bad guys—has nothing to do with it. Our sense of humanity cannot be improved by parodying those who, though once our enemies, are as much flesh and blood as we are.

While I'm griping, I'll raise one more objection: the gutteral language the Germans speak. The escaping prisoner is met with such grunts as: "Achtung!" "Kaputt!" "Was ist das?" And, of course, "Schweinhund!" They sound more like something that crawled out of your toilet than like people.

If you can step beyond the moral questions, you'll find that Castle Wolfenstein can be an intriguing game. Whether you're using the keypad, joystick or paddles, you need to move quickly and shoot accurately. You also learn in short order that it often pays to think ahead and plan your strategy before you barge into a chamber. And once you've escaped from the castle, the program will offer you a different series of chambers.

Eventually, if you're persistent, you can move up the ranks from private to general or beyond (the documentation only tells you that the highest rank is ???????). But the question remains. Can a program that encourages such stereotyping and promotes killing be all that much fun?

I think I prefer the ectoplasms from space. At least, I can convince my imagination that they are truly evil.

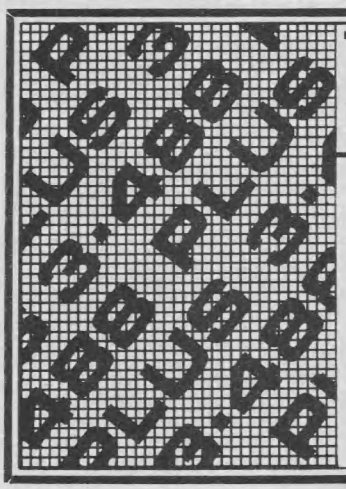
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Eric Maloney
***Microcomputing* magazine**

Apple-DOC

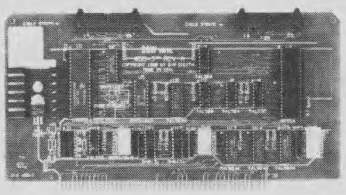
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How many times have you been merrily programming away in Applesoft BASIC, assigning variables one after the other, only to later find out that you



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carelessly assigned the same name to two completely different variables?

How often have you wished you could print a list of every variable along with every line number on which the variable occurred?

And have you ever wanted to change the name of a variable or literal throughout a program but decided it would be easier to work around the problem rather than laboriously go through the program one line at a time looking for every occurrence?

You can now do all this and more with a set of programs called APPLE-DOC by Roger Wagner. The package consists of three major programs called VARDOC, LINEDOC and REPLACE. And, if you order the disk version, you also get a bonus program called LISTER (as well as a few other features). The programs may be used with either ROM or RAM Applesoft and are available for both tape and disk systems.

VARDOC will produce a list of every variable used in an Applesoft program and all the line numbers that each occurred on. You may analyze all or a selected part of your program and output the results either to the screen or printer. As an added feature you may label each variable with a description (descriptor) of what that variable does. You are free to enter anything you wish with no restrictions as to format, commas, quotes, etc. The Descriptor file is saved to disk and may be optionally printed to the screen or printer along with the variables. This is especially handy if you wish to document a program for another user.

Furthermore, it makes possible the reduction of the use of REM statements in programs by creating files separate from the program itself. Think of the possibilities. Now you can document your programs in great detail without increasing the actual size of the program. Also, if you go back to modify a program six months or a year from now, you won't be lost wondering what all those cryptographic variables mean.

LINEDOC generates a list of every line that is called by a GOTO or GOSUB, as well as all the lines each is called from. Also, any line numbers called that are no longer in the listing are listed at the end of the table with an asterisk to alert the user. As with VARDOC, optional descriptors may be assigned to each line and printed along with the listing. If you have ever changed or deleted a subroutine and wondered if you had found and changed every referenced line, then LINEDOC is a programmer's dream come true.

REPLACE does just that. It can quickly and easily rename any or all occurrences of any variable or literal. You can change variable types, replace constants or referenced line numbers, replace any set of characters or BASIC statements with any other set or list all the line numbers a given string occurs on. The changes can be global or limited to just a few lines and can be made with or without reviewing the line being changed. As each line is presented, you have the option of changing it or leaving it alone.

Another handy routine in the REPLACE program is the Truncate & Replace a Literal function. This function is rather like the Replace a Literal function except that it only replaces everything in the line from a desired point on. This feature is extremely useful for removing REM statements that occur at the end of program statements. REM statements that are the only contents of a line but are referenced by a GOTO or GOSUB may simply be truncated and replaced by a colon (:). In a large program of, say, 8–10K, the stripping of all the REM statements (in just the operational version) could result in a memory savings of 1 to 2K, depending on the length and number of the REMs. Since the time taken to remove all the REMs is only a couple of minutes, you can maintain and update master versions which are full of REMs, and then strip them away for the operational versions.

All of the programs function very fast and without errors. It only takes 15–20 seconds to document all the variables in a moderately-sized program, and the cross references are done even faster. The programs are easy to use. Just LOAD the program you want to document and execute the APPLE-DOC routine you wish. When finished, your program is restored in memory intact and ready to save or run. If you're using the tape version, you'll have to type in various PEEKs and POKEs before loading and running the programs. Although only the disk version was tested, I'm sure the little extra effort the PEEKs and POKEs take would be more than offset by the savings of time and energy APPLE-DOC affords.

The reference manual that comes with the programs is reasonably well done, and the operation of the programs is self-explanatory. Information is given on modifications for different printers and an explanation of the mechanics of the programs is presented for those of us who have to know how things work.

As mentioned earlier, disk users receive several little bonus programs on the same disk. The main program is called LISTER and it does just that. It LISTS all or part of your Applesoft program to either a printer or a disk text file. When listing to a printer, the program makes full use of your printer's maximum line width and prints a nice title banner at the top of the first page. By listing to a text file you can edit the program listing with some of the text editors that are available, or you can execute the program into other Applesoft programs. If you have, for example, a sort routine in one program that you want to use in another, simply list that part of the program as a text file and then execute it into your other program.

The other goodies that come on the disk are really promotional demos for Roger's Easel, a low-resolution color sketch program that uses the game paddles to draw pictures with Apple's low-resolution graphics feature. The program allows you to save the pictures to either tape or disk and then link your graphics to your own Applesoft and Integer programs. Anyone interested in games and educational programs might want to look more closely at this package.

As of this writing, the price of APPLE-DOC has been increased from $24.95 (a great bargain) to $34.95 (still a bargain in today's economy). Included is another program module called CONDOC, which is supposed to document all numeric constants. Although the version reviewed here did not have this feature, I'm confident that CONDOC will perform as well as the others. All in all, whether you're just a budding novice or an experienced programmer, APPLE-DOC will prove to be an invaluable addition to your library.

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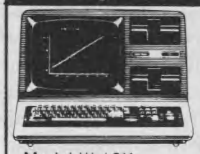
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(continued from p. 194)

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MICRO QUIZ

(from p. 8)

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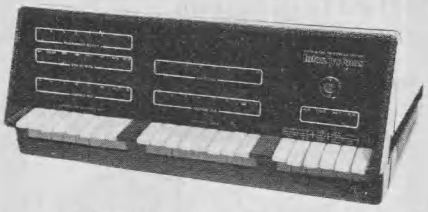
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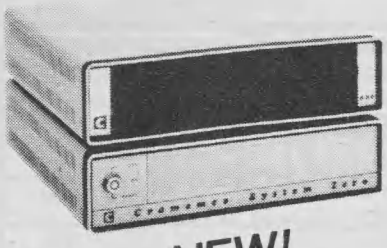
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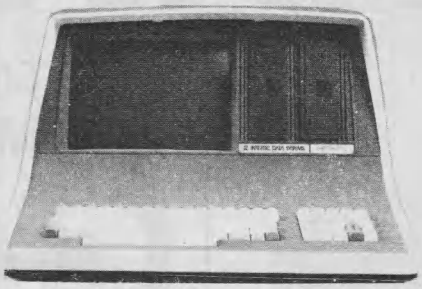
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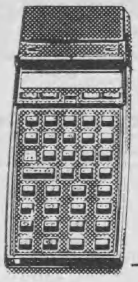
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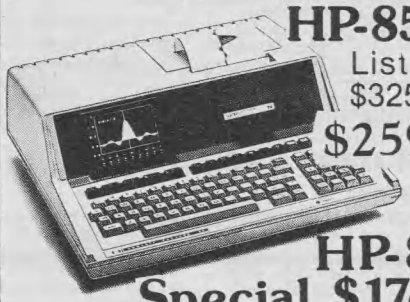
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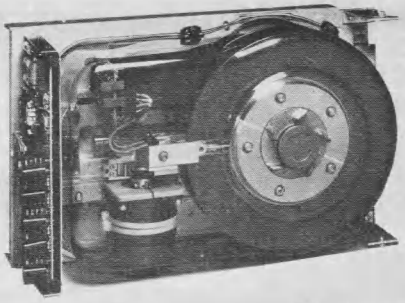
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10 Megabyte
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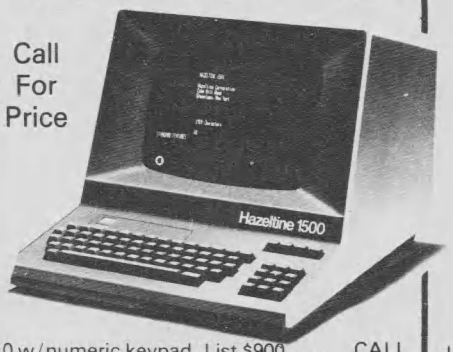
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1410 w/numeric keypad, List $900 ..... CALL
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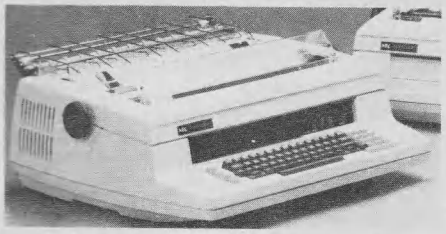
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SPECIAL $729

IQ 130, List 699 599
IQ 135 749
IQ 135G 799
IQ 140, List $1495.. **SPECIAL $1149**

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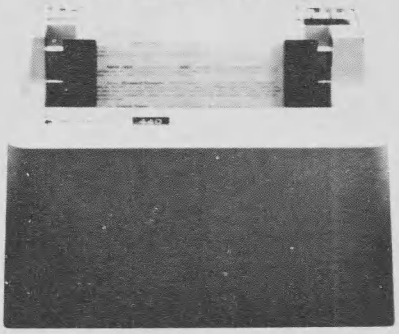
704-9 RS-232 180cps $1595
704-11, parallel, friction, tractor ..... CALL
NEW 737, parallel, friction, tractor..... CALL
739-1, List $995..... 689
739-3, List $1045..... 839
779-2, w/tractor (same as TRS80 Line printer 1) List $1350 799

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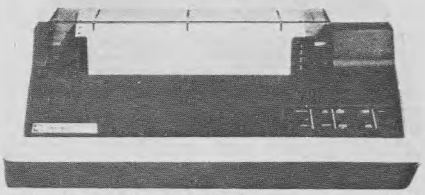
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By Lloyd Dinkins

Down on The Farm

Farming Is A New Market For Programmers

America's largest and most important industry is emerging as potentially the biggest computer market, but it has fewer than 200 good programs.

That industry is farming. Good programmers in the next few years should find a bumper harvest of opportunity among farmers and ranchers. A recent survey shows that almost four percent of the nation's farmers already own microcomputers, with the number rising rapidly to a projected 50 percent by 1987.

But programmers must study this market before trying to write software. Farming has special tax laws, payroll procedures and other unique business practices. The average program that fits a hardware store or small service company is of little use in agriculture.

This ground-level market also offers the chance to customize programs. Since no two farms are alike, many farmers will want custom software. At the least, programs should permit user modification or special configurations.

Here is a partial list of areas in which new, farm-specialized programs might be written:

- land measurement and management;
- keeping track of the many supply items used in farming, such as fertilizers, pesticides, seed and fuel;
- livestock feeding rations to optimize profits;
- soil fertility management for most cost-efficient plant nutrition;
- commodity price trends and analyses;
- crop-marketing alternatives for best profit;
- tax management under the special laws that apply to farmers;
- management of the many on-farm processing operations, such as cotton ginning, grain drying and feed mixing plants;
- loan-application information processing;
- loan interest management; and
- selection of government program options.

And, since computer programs are deductible business investments, the prices of such software need not be set at some poverty level. If your programs can do a job for a farmer, they should command a decent price.

As with any field focused on agriculture, regional differences must be accounted for. A program for management of potato production in Maine would have no value in the High Plains of Texas, for example, where there's hardly enough rainfall to boil a potato, let alone grow one.

These regional differences also extend to on-farm computers. Farmer-owned machines in the South and Midwest are mostly from Radio Shack. In the West, the Apple seems to be the favorite brand, with Heath/Zenith catching up on RS and Apple in the East and North. Most farm computers have at least one floppy disk drive.

The agricultural computer market probably will want BASIC programs in the foreseeable future, although some uses might be suited for machine-language software.

Keep in mind the several branches of farming, too. The categories shown in Table 1 give a broad-brush view, and are not necessarily the only way to define the different farming enterprises. Also, there are minor branches such as those producing sheep and poultry.

Add to these the many processing steps required for crops and livestock, and you begin to see just how big agriculture is. These processing phases include grain drying and handling, meat packing, soybean and cottonseed crushing, and many, many other post-harvest operations.

Crops

- Row crops such as corn, soybeans and cotton
- Small grains such as wheat and rice
- Forage crops—hay and silage
- Horticultural crops such as fruits and vegetables

Livestock

- Beef cattle
  - cow-calf producers
  - feeders
- Dairy cattle
  - milk producers
  - herd replacement operations
- Hog producers

Table 1.

No Hayseeds

In case you have the old idea that farmers are a bunch of dummies, you may want to brush up and enter the 20th century.

Proportionately more college degrees are held by commercial farmers (i.e., 350 acres or more) than by white-collar workers; agriculture in its widest sense generates more dollars than the auto, steel and communications industries combined; and farmers are innovative, technology-oriented businessmen willing to try new methods.

In case you're wondering if farmers can afford to buy programs, look at their financial statistics for 1980 (latest year available): The $140 billion total they spent on production expenses translates into a record $56,000 per-farm average.

They spent about 16 percent ($21 billion) on farm "services," including rent, custom-hired work, veterinary services, breeding fees, insurance, marketing expenses and hired transportation. Ten percent of U.S. farmers' production expenses were for autos, trucks, tractors and other machinery (surely, they could fit in a few $5000 computers).

When agriculture adopts the micro-

(continued on p. 190)

Lloyd Dinkins publishes the Computer Farming Newsletter, *PO Box 22642, Memphis, TN 38122.*

Your computer.

Compute.

Compute.

Compute.

Compute.

Compute.

Dump...

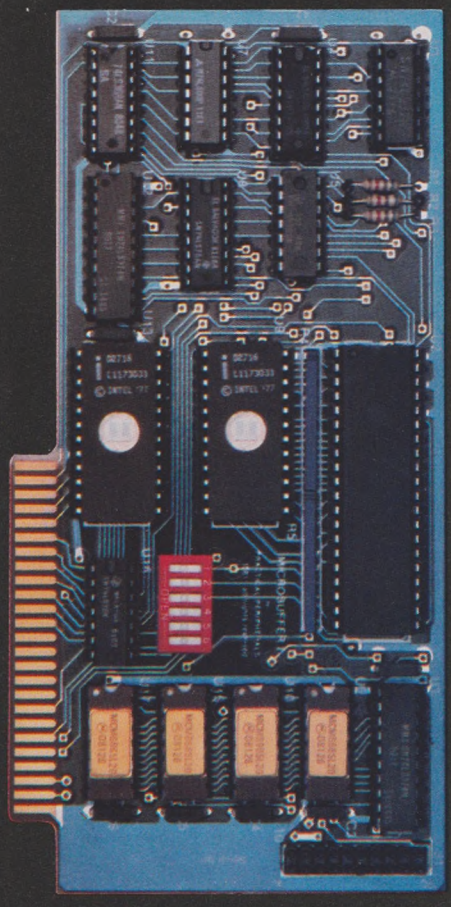
Compute.

Compute.

Compute.

Compute.

Compute.



Your printer.

...Print.

Print.

Print.

Print.

Print.

Print.

New Microbuffer II lets you use your printer without tying up your computer.

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The Microbuffer II, compatible with Applesoft, CP/M® and Pascal, comes with complete print formatting features as well as advanced graphics dump routines for most popular graphics printers.

The Snapshot™ option permits you to dump the text screen or graphics picture to the printer while any program is running — without interuption.

The 16K Microbuffer II is available for $259. And the 32K version, for $299. The Snapshot option is $69.

So why waste time while your computer waits for your printer? Ask your computer dealer for the Microbuffer II or call us for the name of a dealer near you.

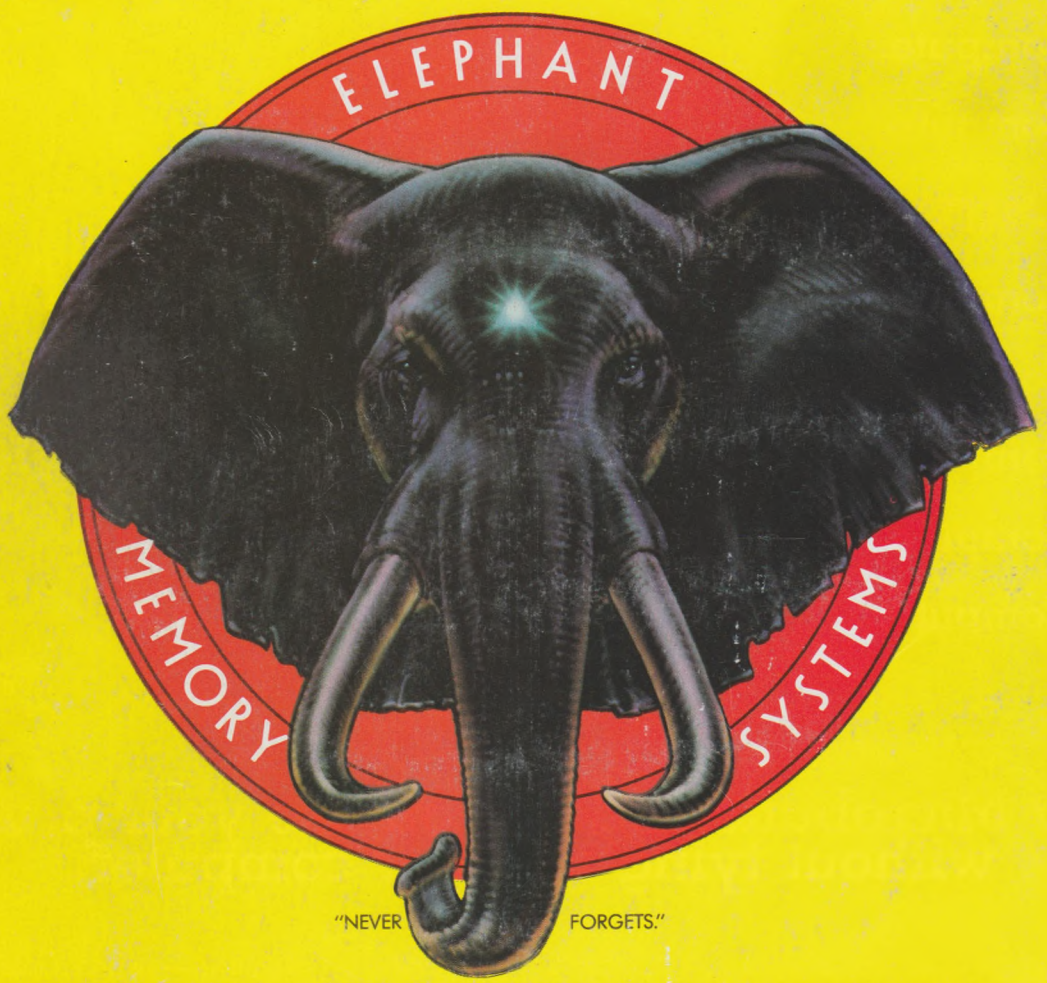
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